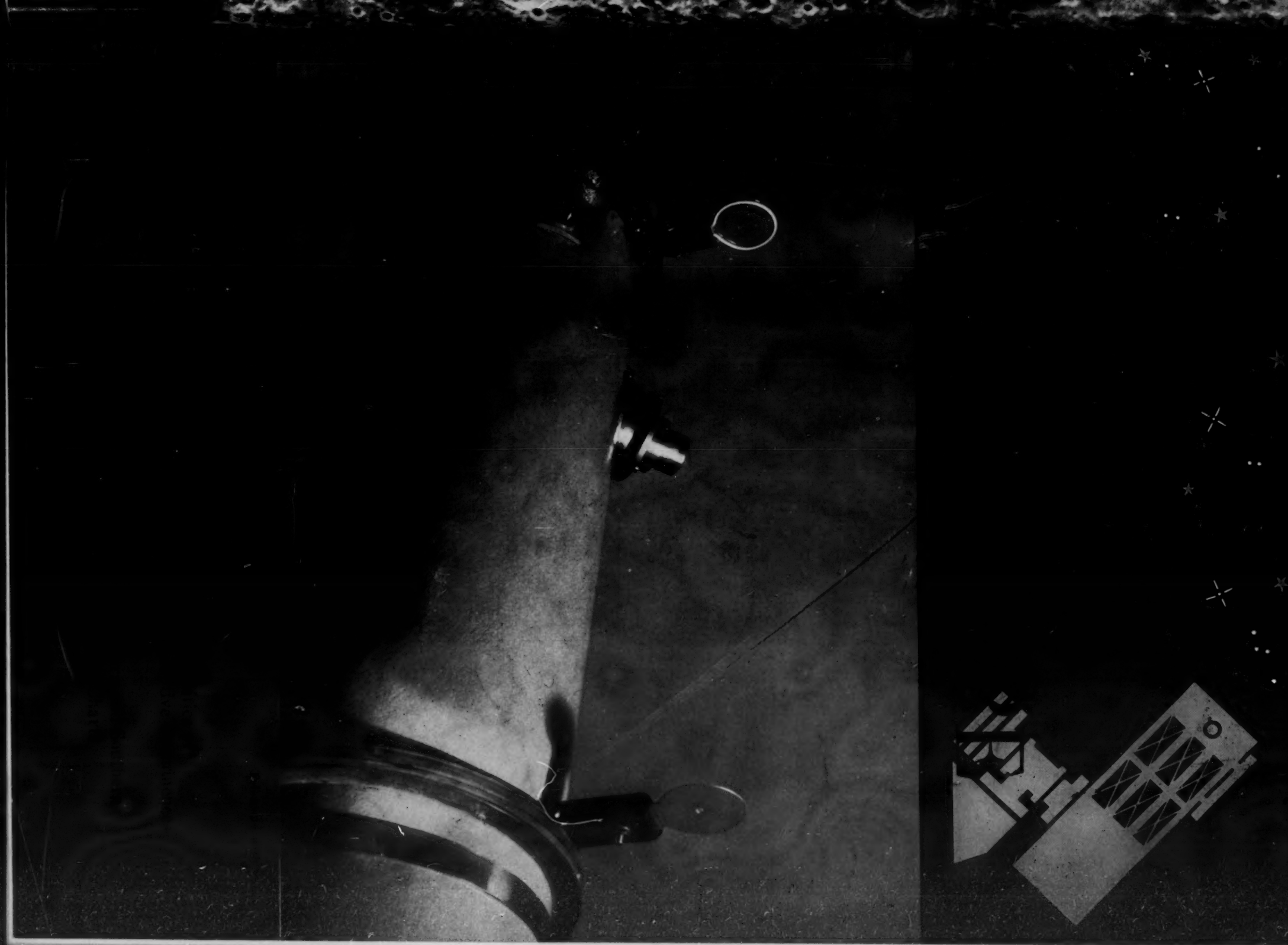

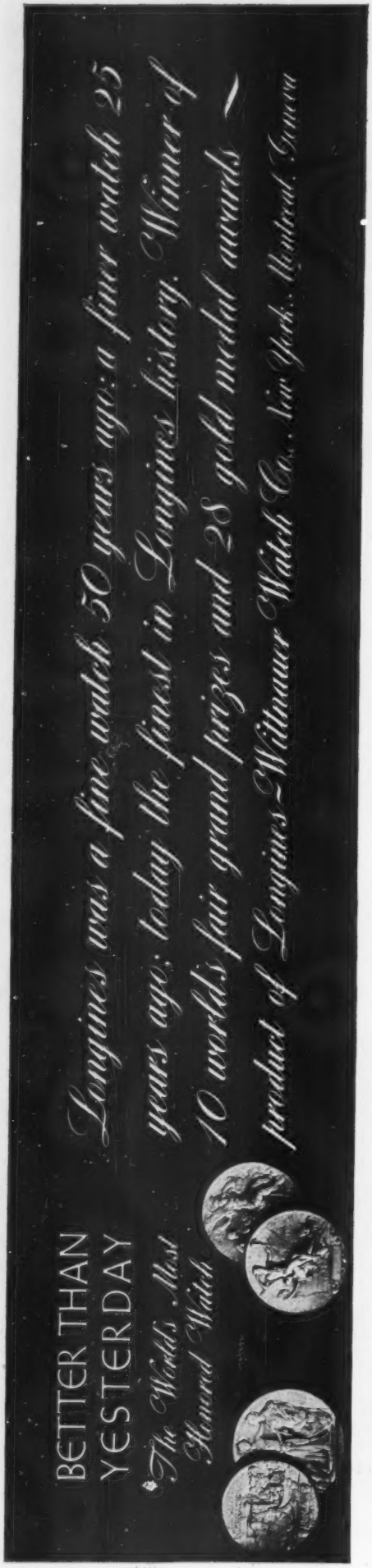
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Sky and TELESCOPE

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The Editors Note . . .

VACATION IN OCTOBER is proposed by the president of the American Meteor Society, Dr. Charles P. Olivier, of the Flower Observatory, Upper Darby, Pa., in his recent article on the expected shower of meteors associated with Comet Giacobini-Zinner. He suggests that vacations of a few days be arranged for the period from October 8th to 10th—so one may stay up all night and sleep all day! Surely, no effort can be too great with the reward of observing what may be a marvelous display of meteors, particularly since every amateur is in a position to make valuable observations of this phenomenon.

In the article by Dr. Fletcher G. Watson in this issue of **Sky and Telescope** and in Dr. Olivier's article in the August issue of **Popular Astronomy**, sufficient information is given for anyone to plan an observing program. Each prospective watcher should decide in advance whose observational suggestions he will follow, as there are some differences in the way in which Dr. Watson and Dr. Olivier wish the observing and recording done. Various methods of analyzing and interpreting data are, or course, scientifically desirable from the standpoint of the development of theory and observational practice.

Both these articles stress that a simple and practical program is better than an elaborate one which cannot be satisfactorily completed. If the meteors come thick and fast, inexperienced observers may become distracted, so keep your plans simple, and perhaps allow time on your observing schedule for pure enjoyment of the beauty of the spectacle. Organize small groups and divide the work so no one will have too much. But, above all, observe the sky as continuously as possible on these three nights. Here is an opportunity for societies of amateurs to make real contributions — no group can consider itself active in amateur astronomy if it lets this opportunity pass without planning and carrying through a definite observing program.

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OCTOBER, 1946

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BACK COVER: A portion of the moon near first quarter, from a Lick Observatory photograph taken with the 36-inch refractor by J. H. Moore and J. F. Chappell. The reproduction is reduced 10 to 7 from a 7.8 enlargement of the original negative. This plate is the last of the series of nine required to make up the complete first quarter. (See In Focus.)

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Giacobinid Meteors and What To Do

By Fletcher G. Watson, *Harvard University*

ASTRONOMERS ARE HOPING that on October 8th, 9th, or 10th the earth will encounter a large number of particles lagging behind Comet Giacobini-Zinner and that one of the greatest meteor showers in history will result. The circumstances seem very favorable, but no one can guarantee a spectacular shower as the earth is playing a cosmic game of blindman's buff with these tiny particles, which cannot be detected until they blaze to destruction in the upper atmosphere.

On October 9, 1933, as dusk fell over Europe the sky was filled with faint meteors radiating from the head of Draco. For a short time the frequency increased, until around 20:00 GCT the maximum was reached when some observers counted 350 meteors a minute—six each second! An hour later the rate had fallen to 1/10 this maximum and by the time darkness had fallen over the Americas the shower was barely detectable.

The location of the radiant point in Draco was immediately recognized as associating this shower with the faint comet, Giacobini-Zinner, which has a period of 6.6 years. This comet belongs to the two dozen or so with short periods known as Jupiter's family. All members of this group pass near the orbit of Jupiter and are continually undergoing orbital variations, usually slowly but sometimes quite abruptly, as a consequence of periodically being in the same part of space as the great planet, which pulls on them to speed them up or slow them down. All these short-period comets have orbits of low inclination, which means that they always remain fairly near the plane of the ecliptic. One fifth of them come to perihelion within the earth's orbit, thereby providing chances for the earth to pass near their orbits. Even when this is the case, the comet and the earth will rarely be simultaneously near this cosmic grade crossing. Thus the chances for the earth to approach really near one of these comets is very small.

In 1933, the earth passed the orbit of Comet Giacobini-Zinner at a distance of 500,000 miles 80 days after the comet had passed that point in its orbit. Even so, the most intense meteor shower of the century appeared. In 1946, at 02:30 GCT on October 10th (9:30 p.m. EST, October 9th), according to calculations by Dr. L. E. Cunningham, at the University of California, the earth will pass the comet's orbit at 131,000 miles, only eight days after the comet has passed by. Fig. 1 shows the intersecting orbits of the comet and the earth, while Fig. 2 illustrates in more detail

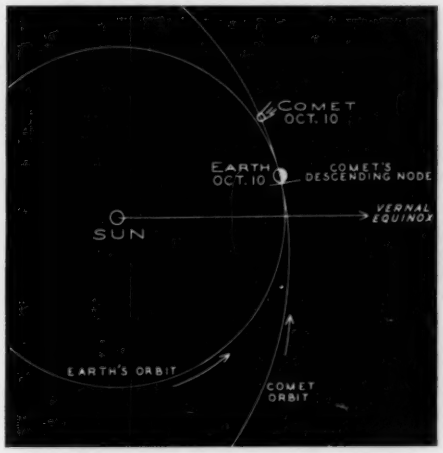


Fig. 1. The orbits of the comet and the earth intersect very nearly at the point where the earth will be on October 10th. This diagram shows the orbits as they would appear from the north ecliptic pole.

how the comet scoots down across the intersection eight days ahead of the earth. What will happen when the earth passes this point cannot be foretold, but circumstances could hardly be more favorable for the appearance of an extraordinary meteor shower.

A comet seems to be a great volume of diffuse gas surrounding clusters of solid particles. Due to slight differences in the gravitational disturbances, mainly those of Jupiter, acting on these various clusters of meteoroids, their paths are changed slightly and in time the groups drift apart and disperse. Thus they become separate "flying gravel banks" moving near the orbit of the parent comet, but running ahead or lagging behind. Existing information on the structure of such swarms is exceedingly small, for no nearly adequate records were kept until in 1872 and again in 1885 the earth plowed into swarms of particles shaken loose from Biela's comet. Since then the only other intense meteor shower has been the unexpected Giacobinids of 1933. This time, when we are aware that circumstances favor the appearance of a great shower, a really scientific study of this cometary debris should be made.

Professional astronomers will utilize their special equipment in studying certain aspects of the shower. But some are likely to be plagued by clouds. A great quantity of valuable scientific information can be obtained by conscientious amateur observers, working alone or in groups.

Because the earth and the meteoroids are moving in almost the same direction when they collide, the particles overtake the earth and strike the atmosphere with a velocity of only 14 miles per second. In 1933, the majority of the meteors were of the 3rd and 4th magnitudes with only a few per cent of the 1st magnitude or brighter. If this is the case in 1946, the brilliance of the shower will be greatly reduced by the

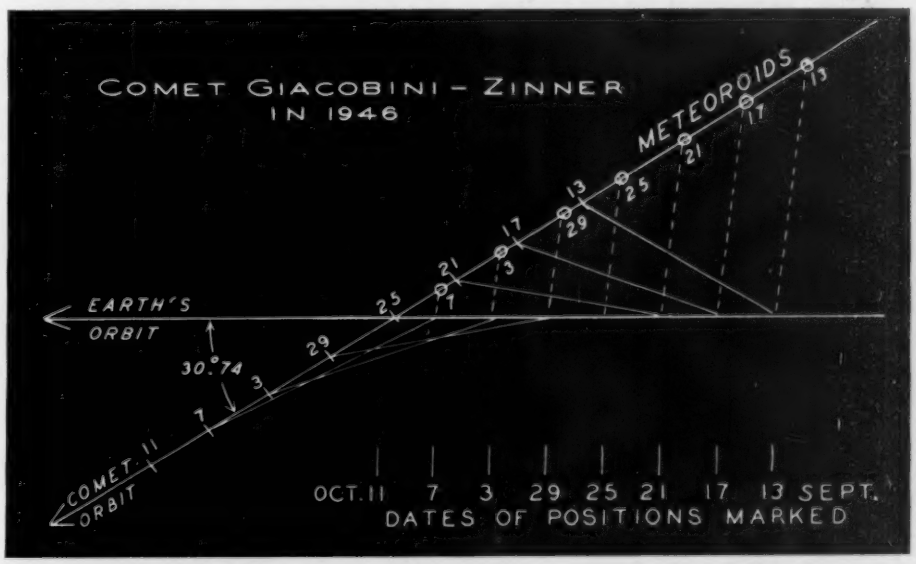


Fig. 2. The intersection of the orbits as seen from the sun (at right angles to Fig. 1). The solid lines join corresponding positions of the comet and the earth. The dotted lines join the earth with whatever meteoroids lie far enough behind the comet to enter the earth's atmosphere on October 10th — this distance is about 32 million miles behind the comet. Note that the inclination of the comet orbit is 30°.74. The diagram is adapted from one supplied by Dr. L. E. Cunningham, of the University of California.

moon. It will be full October 10th, located in Pisces, and will illuminate the sky so that faint stars and faint meteors cannot be seen. It is recommended that observers face away from the moon and watch the triangle between the zenith, the radiant near the head of Draco, and the celestial pole.

Observations of this meteor shower should help in the study of both orbital and physical problems. Any painstaking amateur can contribute to the understanding of the physical structure of the swarm, or swarms, and the distribution of particle sizes within the swarms. This is accomplished through counts of the number of meteors seen within short intervals, preferably five

Fig. 3. The region of the sky containing the radiant point of the Giacobinid meteors, plotted to use facing north early in the evening. The radiant is in the head of Draco. The stellar magnitudes given are useful in determining changing sky conditions, and for comparison in estimating meteor magnitudes.

minutes long, and a record of the magnitudes of the meteors. Such counts, to be of greatest value, must be standardized in a simple way so that records from various places can be compared. As shown in 1939 (*Proceedings,* National Academy of Sciences, *25,* 243, 1939), the number of meteors seen and their mean magnitude vary directly with the limiting magnitude of the observer. Each observer should record the magnitude of the faintest star he can see, using for reference the magnitudes shown in Fig. 3. If the transparency changes, the corresponding changes in limiting magnitude must also be noted. The presence of clouds within the observing field must be noted and their coverage estimated, for example, 2/10 represents clouds over one fifth of the area under observation.

Fig. 3 can also be used as a scale for estimating the meteor magnitudes. Since all the particles move with identical velocities, their differences in brightness, when reduced to standard conditions in the zenith, are directly related to the differences in masses of the particles. Relatively little information on this subject exists, but what there is suggests peculiarities in the particle sizes of various showers. Further information on this subject is greatly desired as it has cosmogonical implications.

The services of a recorder will greatly facilitate study of magnitude frequencies. The observer then need only watch the sky, preferably an area with the radiant included, and call off the magnitudes of Giacobinids and non-Giacobinids as they appear. The latter will come from other parts of the sky than the radiant in Draco. The recorder notes the occurrence of the magnitude in a previously prepared form and starts a new set of records each five minutes. The following table shows part of a hypothetical set of records with the additional information necessary to make the observations significant.

Date: Oct. 9-10, 46; **Observer:** X. Y. Zee; **Place:** Bloomington, Ind. (39° 10′ N, 86° 31′ W); **Field:** zenith; unaided eye; no clouds. **Stellar limit:** 4.2.

CST	Mag.	−2	−1	0	1	2	3	4	Total
2045-50	Giac.	1	0	2	5	17	12	4	41
	NonG.	0	0	0	2	1	3	1	7

Observers having wide-field binoculars, such as 7 x 50, or telescopes with low power and wide-field eyepieces—rich-field telescopes—can extend the magnitude and frequency counts to telescopic magnitudes. When this is done the telescopic observations should be accompanied by naked-eye observations including the telescopic field. It is believed that magnitude estimates made through optical devices should be on the familiar naked-eye scale rather than on a telescopic scale. From a graph showing the faintest star observable through the optical aid, the magnitude scales can later be shifted to the telescopic region. Telescopic observations in the zenith are easily made when the telescope is mounted horizontally and a front-silvered mirror is placed at an angle of 45 degrees before the lens. This permits the observer to sit naturally and comfortably while providing records that require no reductions to zenithal conditions.

Since the relationship between this shower and Comet Giacobini-Zinner is known, radiant location is not of primary concern. The radiant is, however, likely to be an area rather than a point. Information on the size of this area and how its position shifts with time and zenith distance are valuable. If the shower is intense, stationary or near-stationary meteors are likely to provide the best indications of radiant position, for such meteors will be directly approaching the observer. If, however, the shower is weaker, the radiant will best be located from plots of carefully observed trails. Such plots should be made on star charts based on gnomonic or other projections which show great circles in the sky as straight lines. Care must be taken not to overcrowd the plotting sheets, otherwise their interpretation becomes almost impossible.

Height and velocity determinations require simultaneous observations from two points separated by 30 to 50 miles. If the meteors are very numerous, identification of the common objects in the two sets of records will be difficult. Careful timing by watches compared with radio time signals before and after each observing period will aid such identification. As it is important to have the greatest parallactic angle, it is suggested that both observers include their zenith and the region toward the other observer. The most experienced meteor observers may wish to add estimates of flight duration so that velocities can be determined. Since the velocity of the meteors is known, this material will permit evaluation of the limitations of visual observations for meteor velocities. The highest precision in observing and plotting is essential in this type of observation and it is not recommended to the casual or inexperienced observer.

Every effort should be made to obtain photographic observations of the shower even though they will be hindered by the strong moonlight. To obtain such pictures the cameras must be operated at full aperture; focal ratios of f/4.5 or faster will be most satisfactory. The length of exposure possible without excessive sky fog, a density of around 0.5, will probably not exceed 30 minutes. Tests during the moonlit nights preceding October 8th will indicate the limitations of each camera. In every case the fastest film available should be used. Since the moon will be in the east and southeast during the evening, the cameras should be pointed at the zenith, the radiant, or the pole. The times at which the shutter is opened and closed on each exposure must be accurately recorded.

If prisms are available, some may wish to attempt photography of meteor spectra. The prism should be turned to have the thin edge parallel to the direction of flight from the radiant in Draco. For more details on meteor photography, see papers by P. M. Millman in *Popular Astronomy, 41,* 298, 1933; *Journal* of the Royal Astronomical Society of Canada, *31,* 295, 1937; *Amateur Telescope Making, Advanced.*

The following recommendations for an observing program are arranged with the more difficult items at the bottom. The relatively inexperienced but conscientious observer will do well not to undertake too complex a program. Parts 1, 2, and 3 apply to all programs.

1. Record your location (preferably

This drawing shows the great meteor shower of 1833 (Leonids).

also latitude and longitude), the time system used (EST, PST, etc.), the field of view, any binoculars or telescopes used. Inadequate description of the observing conditions may greatly lower the usefulness of the records.

2. Record the time at which the shower is first noticed, is at maximum, and is last detected.

3. Each individual observer should record at intervals of one hour the faintest star *he* can see. If this varies from haze, record the limiting magnitude frequently.

4. Count the number of meteors seen in each 5-minute interval.

5. Count the number of meteors of each magnitude, or better each half magnitude, appearing in each 5-minute interval.

6. Locate the position of the radiant using plotted observations grouped over intervals not exceeding an hour.

7. Make such telescopic and photographic observations as are practical.

Use of prepared recording forms is desirable. Also a practice session of observing at an earlier date will improve your technique and indicate what lights and other equipment are necessary.

There is no way of foretelling if or when this meteor shower will appear. The night of October 9-10th is the most probable but some meteors may appear on the night before or the night afterwards. Systematic observations on October 8th, 9th, and 10th should be made by all who expect to provide information of scientific value. Negative observations are valuable as they indicate where the meteors "were not"; record all of your efforts. Begin at dusk and maintain as long watches as possible, for the radiant point will set slowly and will be circumpolar for observers north of latitude 36° north. At midnight observers at latitude 40° north will find the radiant still 25 degrees above the northwestern horizon. It is possible that the earth will encounter distinct swarms of particles and that the meteor frequency will show several maxima during these three days.

The writer will be pleased to analyze observations forwarded via *Sky and Telescope* — provided, of course, there are any Giacobinid meteors in 1946.

ASTRONOMICAL ANECDOTES

MOON - LIGHTNING AND METEORS

THIS MONTH, on the 9th, if there is anything in the law of gravitation, we should see a shower of the Giacobinid meteors. In 1933, under less favorable circumstances, a shower estimated to have totaled 20,000 per hour at its peak was observed in Europe. There will be a full moon this year, and that will kill most of the meteors; maybe we shall see only a thousand per hour!

I'll come back to meteors presently, but now here is something from the August 9, 1946, issue of *Science*. It's a letter to the editor, from N. J. Giddings, of the Bureau of Plant Industry, Riverside, Cal. The observation he reports was made on June 17, 1931, at 7:40 p.m. (Pacific standard time, presumably). He wrote the Mount Wilson Observatory regarding the phenomenon, and the reply very courteously discounted his observations. I must confess that I discount them, too, but here is what he says.

"I happened to glance at the fine, clearly outlined new [young] moon; suddenly some flashes of light streaked across the dark surface but definitely within the limits of the moon's outline. I continued to watch it and saw similar flashes streak across the moon again in a moment or two. Without mentioning what I had seen, I called my wife's attention to the new moon. When I asked her to watch it closely to see if she noticed anything strange, she said, 'Oh, yes, I see lightning on the moon,' adding that this appeared to be confined to the moon. We watched it for 20 or 30 minutes, during which the phenomenon must have occurred at least six or seven times. At the time, I was inclined to attribute the phenomenon to some sort of sunlight reflection from mountain peaks on the moon or possibly some sort of electrical activity. . . ."

Has anyone else ever seen such a thing? I think it very strange that this observation of 15 years ago should now suddenly come to light, without any report — at least, none I have ever seen — of anything comparable. I am sure that I would discount it completely, despite the apparent agreement of the observers. But how many thousands of unbelievable observations may we discount, and remain scientists?

Now to return to meteors. The unilluminated portions of the moon, between new and full, face in the direction of the earth's orbital motion and should therefore encounter the most meteoroidal bodies. C. C. Wylie once estimated that about 6,000 bodies of mass 10 pounds and more enter the earth's atmosphere each year. The moon should suffer about 450 such collisions each year. On the average, a quarter of the moon's surface is seen dark, and this whittles the number down to about 100 collisions per year, or one each three or four days.

Such a collision should produce a visible flash on the moon's dark portion — visible certainly with a small telescope, perhaps even to the unaided eye. Lincoln La Paz and others have demonstrated that a 100-pound body impinging on an airless moon would produce a flash of apparent magnitude −1, so a 10-pound body would produce a flash of perhaps apparent magnitude 2. Why are they never seen? There are a very, very few scattered reports of such flashes, but they are too scattered.

Let there be a campaign of observation by amateurs possessing telescopes. Each month, between moon-ages 3 and 12 days, let the dark portion of the moon be observed with a magnifying power of about 100 diameters, by a group of amateurs strung all around the world. The observing periods should be about two hours in length, with overlapping periods from one observer to another. All instances of suspected flashes should be timed accurately, to the nearest half minute, at least, so comparison may establish some of them as real.

This seems to me to be the only way to prove that the moon is really atmosphereless. If those flashes are not seen, something is wrong with the whole idea of meteoritic impact as the explanation for lunar craters. R. K. M.

AMERICAN ASTRONOMERS REPORT

Here are highlights of some papers presented at the 75th meeting of the American Astronomical Society, held at the University of Wisconsin on September 8th to 11th, on the invitation of Dr. Joel Stebbins, director of the Washburn Observatory. Further reports of papers will be published in Sky and Telescope *next month, and complete abstracts will appear, as usual, in the* Astronomical Journal.

Yale Proper Motion Studies

AT YALE University Observatory work continues with unabated effort on the compilation of catalogues of star positions and motions so essential to the work of a large number of astronomers. Dr. Ida Barney reports that soon to be published is a Yale catalogue of photographic positions for stars in the zone of the sky between declinations +9° and +20°. She has made a special study of the positions of some 2,430 stars which are common to this new catalogue and to the *General Catalogue* compiled at the Dudley Observatory in Albany.

By applying the proper motions in the *General Catalogue* to the positions of the stars given there, Dr. Barney reduced the GC stars to their positions for 1940. This made it possible for her to compare the GC positions with those of the same stars in the Yale catalogue, for which the plates were taken in 1940. The differences in position, Yale minus GC, show a systematic run; this was to be expected, for most of the Yale stars depend on observations at Greenwich Observatory for the definitive or absolute values of their positions. But after the systematic difference had been allowed for, there still remained differences which indicate the *General Catalogue* proper motions have a probable error about 25 per cent larger than given in the catalogue for stars in the zone +9° to +20°.

This is not the first time Dr. Barney has made such a comparison. Several years ago, she and the late Dr. Frank Schlesinger worked on stars in the zone from 10 to 20 degrees south of the celestial equator. The difference found then for stars common to the Yale and GC catalogues in that zone was about 35 per cent for the epoch 1933.5 (instead of the 25 per cent for 1940 for the northern zone). The current work shows that the GC proper motion probable errors should be increased for the northern stars in the *General Catalogue* as well as for the southern ones. The increase applies especially to the probable error for the *proper motion,* and not to the position at mean epoch of the GC.

Cosmic Static

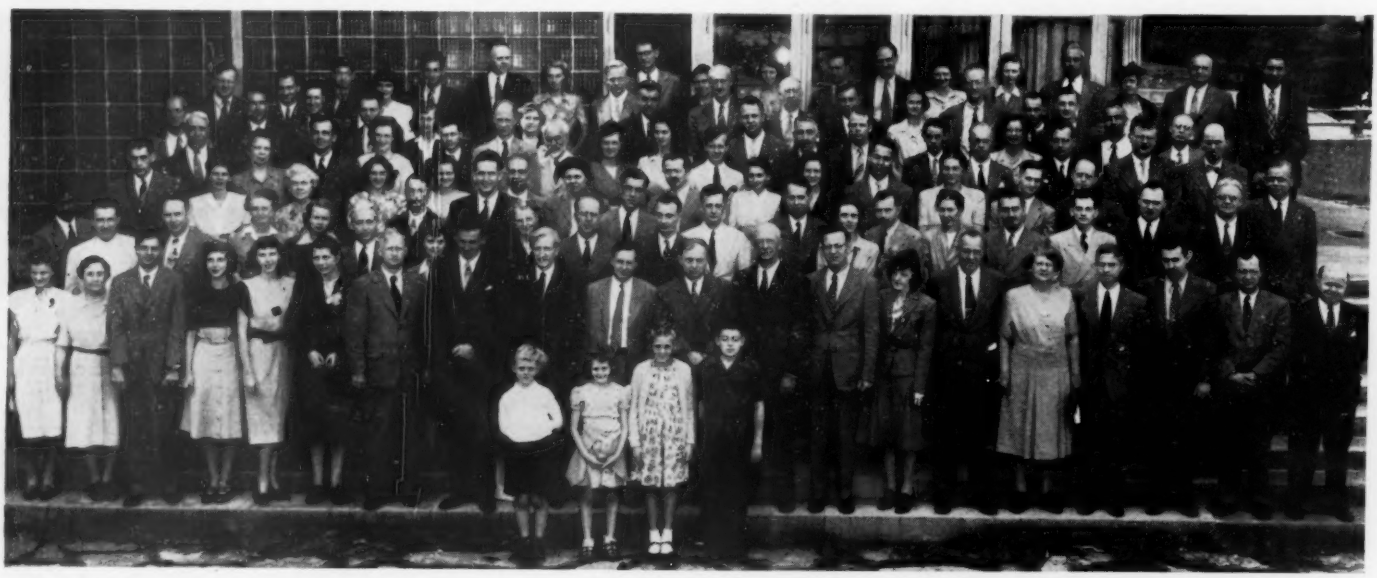
AT WHEATON, Ill., for the past nine years, Grote Reber has been investigating radio waves of extraterrestrial origin with specialized apparatus consisting principally of a sheet-metal mirror 31.4 feet in diameter and of 20-foot focus, and acting as the antenna of a radio receiving set tunable to various frequencies.

The cosmic static appears as a hissing sound in radio-receiver earphones. Extensive surveys at 160 megacycles have indicated close correlation between maximum signal strength and the Milky Way, the strongest signals coming from Sagittarius and the weakest from Perseus, with minor maxima in Cygnus, Cassiopeia, Canis Major, and Puppis. The width of the Milky Way as determined from these cosmic static measures is only a few degrees of arc.

Similar static produced by the sun itself has been observed, and it is of the proper intensity for the sun's distance and known rate of radio energy output. But when the tremendous distances of the stars in the Milky Way are considered, the cosmic static received from their direction is millions of times as intense as it should be if the stars themselves were the only source of this energy.

Mr. Reber proposes that interstellar matter is responsible for the production of these long waves of radiant energy. He suggests that the free electrons in space, passing near ionized atoms, lose energy (that is, change their direction and/or slow down) in what are known as free-free energy transitions. The energy so lost to the electron is radiated as a pulse of radio energy.

The intensity of the cosmic static is quite high at the frequencies used by long distance short-wave radio stations; somewhat weaker at the frequencies used in FM and television broadcasting; quite faint at low radar frequencies;



Members and guests of the American Astronomical Society gathered on the steps of the Union at the University of Wisconsin, Madison, on September 9th. Photo by the Camera Commercial.

and below perception on the best equipment for high-frequency radar.

Further development in this field might take place at a low-latitude observatory, so the southern Milky Way could be observed. Mr. Reber also thinks that conditions in the tail of a comet with a large tail might so resemble those in interstellar clouds that such a comet would provide an excellent opportunity to observe nearby cosmic static.

Radio waves of extraterrestrial origin were discovered about 15 years ago by K. G. Jansky, of the Bell Telephone Laboratories.

Comet Orbits

ONLY TWO COMETS are known which can be observed completely around their orbits: Comet Oterma (1943a) and Comet Schwassmann-Wachmann (see page 6, *Sky and Telescope,* September, 1946). Dr. Paul Herget, of the University of Cincinnati Observatory, has computed the orbit of the second of these on the basis of 54 observations extending from 1934 to 1944. Now reliable ephemerides of Comet Schwassmann-Wachmann can be prepared for years to come.

In 1937-38, Comet Oterma passed within less than 1/10 of an astronomical unit of Jupiter, and the influence of the planet on the comet's orbit at that time must have been very great. Unfortunately, the comet was one degree north of the region around Jupiter which Dr. Seth B. Nicholson was surveying with the 100-inch Mount Wilson telescope at that time. Dr. Nicholson was searching for more satellites of Jupiter, and he did find two of them, but the position of Comet Oterma was not observed. Dr. Herget suggests that, inasmuch as Comet Oterma can be observed all the way around its orbit, careful observations be made at both quadratures as well as at opposition. Another close approach of this comet to Jupiter will occur in 1961.

Planet Computations

STUDENTS of the general theory of planet orbits will benefit by the work of Dr. G. M. Clemence, of the U. S. Nautical Almanac Office, in applying a new method for calculating general expressions for the rectangular co-ordinates of a planet as disturbed by other planets—the planet's position at any time may then be found by substituting the time into the general expressions. The method was invented by Dr. Dirk Brouwer, director of Yale University Observatory, and applied by Dr. Clemence to the calculation of certain first-order perturbations of Mars by Venus. The results are in entire agreement with those obtained by other independent methods, and the method was described by Dr. Clemence as "considerably surpassing other methods in rectangular co-ordinates in elegance and efficiency."

Astrophysics and V-2 Rockets

THE MILITARY PROGRAM of V-2 rocket firing at White Sands, N. M., is enabling astronomers to use "extremely expensive apparatus for the exploration of the upper air, and for making preliminary observations outside the major portion of the atmosphere," according to Dr. J. Allen Hynek, of Perkins Observatory. Dr. Hynek is consultant on V-2 rocket problems with the Applied Physics Laboratory of Johns Hopkins University, one of the four groups which plan the scientific equipment sent up in the Army's experimental flights. The other groups are at the Universities of Princeton and Michigan, and at the Naval Research Laboratory.

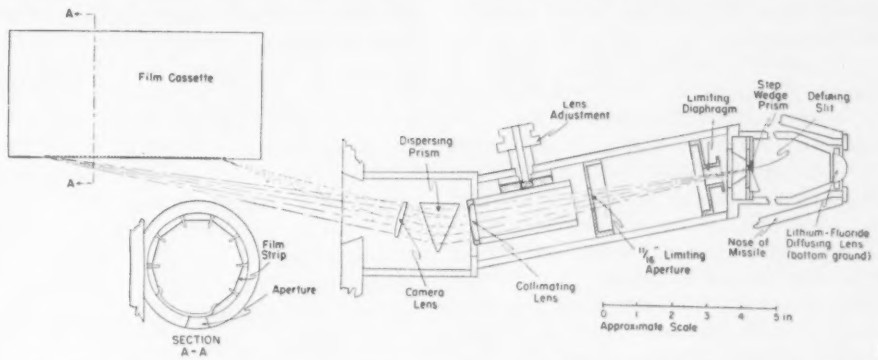
The rocket to be fired on October 24th will be equipped by the Johns Hopkins group, carrying principally apparatus for recording the intensities of cosmic rays and for photographing the far ultraviolet spectrum of the sun. At the astronomers' meeting, Dr. Hynek described the spectrograph designed for the solar observation; its successful operation would for the first time release astronomers from the limitation of earth-bound instruments. They have yet to observe extraterrestrial radiation of wave length shorter than about 3000 angstroms because it is absorbed by the ozone and other layers in the rarefied upper air.

As ordinary glass also absorbs ultraviolet, the prisms and lenses of the spectrograph are of lithium fluoride, with which it is hoped to reach 1500 angstroms or better. As shown in the diagram, the film-recording mechanism consists of a 10-sided rotating steel rod, eight sides of which have affixed to them strips of film. The entire plateholder is encased in a light-tight steel cylinder which preliminary drop tests have shown to be exceedingly rugged. Clockwork controls the exposures, turning successive faces of the polygon into the focal plane as the flight progresses.

It is evident, however, that aiming the spectrograph so the sun will shine exactly into the slit will be practically impossible. A small hemisphere of lithium fluoride placed over the slit will act as a diffuser to pick up sunlight even if the apparatus is not pointed directly to the sun. The V-2 is known to rotate slowly about its longitudinal axis, and the hope is that at least some of the exposures will be taken in a favorable aspect.

Uncertainty in the intensity of the radiation, in the transparency of the sky, and in the orientation of the slit make exact exposure prediction difficult, so a step slit will be employed, making the exposure at one end considerably shorter than at the other. The dispersion will be 50 angstroms per millimeter.

Dr. Hynek stated that the flight of July 30th, in which a height of over 100 miles was attained, indicated the desirability of placing scientific apparatus in the body of the rocket instead of in the warhead. On that flight, when the Johns Hopkins scientists purposely separated warhead and rocket at the top altitude, the rocket was recovered practically intact, although the warhead was not found. Apparently, a rocket without its heavy warhead is better slowed down by the air and so does not destroy itself on landing.



A schematic diagram of the components of the spectrograph for observing the far ultraviolet spectrum of the sun during a V-2 rocket flight.

Recurrent Novae

AS TIME GOES BY, new stars which repeat are becoming more numerous. This is because more repetitions of nova-like outbursts have recently occurred (two this year) and because of the gradual extension of studies of past observations. Harvard astronomers Margaret Walton Mayall and Leon Campbell reported on the behavior of the recent nova T Coronae Borealis, which rose to a maximum in February, as well as on the addition of Nova Sagittae 1913 to the list of repeaters.

T Cor Bor originally rose to the 2nd magnitude in 1866, a performance which it repeated just 80 years later, becoming nearly as bright. Mr. Campbell, who is recorder of the American Association of Variable Star Observers, points out the remarkable similarities in the two light curves. The decrease from maximum to minimum light was practically at the same rate each time, the forms of the

curves at minimum are nearly identical, the rise to a secondary maximum alike, both as regards the time elapsed after the initial outbursts and the magnitudes attained.

"Whatever the underlying causes in the behavior of T Cor Bor at these two outbursts, it would appear that they must be the same. The study of recurring novae thus becomes all the more important," said Mr. Campbell. He stated also that during the present activity of this star more than 700 observations were made by some 60 A.A.V.S.O. observers. During five months following the February maximum, observations were obtained on all but four nights, an achievement possible only through such a co-operative medium as the A.A.V.S.O.

Mrs. Mayall, studying some of the thousands of plates in Harvard Observatory's collection of celestial photographs, has verified the recent outburst of Nova Sagittae 1913. On June 28-29, 1946, at Heidelberg Observatory in Germany, Kurt Himpel found this star to increase from the 12th to the 10th magnitude in four hours, or at double its brightness each 1½ hours. Harvard plates four hours later showed the star already at the 9th magnitude. The maximum observed brightness, magnitude 7.7, was reached on the next night, June 29-30th. The star then decreased steadily until it reached 13.3 on August 15th, 48 days after maximum, the latest observation available.

The parallax of this star was measured by the late A. Van Maanen on plates taken with the 100-inch telescope at Mount Wilson, and found to be 0″.013, representing a distance of only about 250 light-years. He also found a very large proper motion, 0″.08 per year, confirming the nearness of this star. The star appears to be a dwarf with its absolute magnitude at maximum only 2.8, not many times brighter than the sun. In nearness and low intrinsic luminosity, Nova Sagittae 1913 is a peculiar nova-like star. In 1934, its spectrum was similar, however, to those of intrinsically brighter novae.

The list of known repeating novae is now six, Mrs. Mayall reported. They are T Coronae Borealis (1866, 1946), RS Ophiuchi (1898, 1933), T Pyxidis (1890, 1902, 1920), Nova Sagittae (1913, 1946), Nova Sagittarii (1901, 1919), and U Scorpii (1863, 1906, 1936).

One Less Variable

THE STAR Y CETI has been recorded on only two plates, taken at the Cape Observatory on October 7, 1893, and September 26, 1894. Harvard plates taken within 10 days of each date do not show the star, and it has never since been seen by any observer. Mrs. Cecilia Payne-Gaposchkin,

(Continued on page 17)

Amateur Astronomers

THIS MONTH'S MEETINGS

Chicago: On Tuesday, October 8th, Dr. Robert H. Baker, of the University of Illinois Observatory, will speak on "The Stars in 1946," at the meeting of the Burnham Astronomical Society, 8:00 p.m. at the Chicago Academy of Sciences Auditorium.

Cincinnati: "The Solar Prominences" will be discussed by Miss Antoinette Kettenacker, of the Cincinnati Observatory, at the October 11th meeting of the Cincinnati Astronomical Association. The meeting is in the Mitchel building of the Cincinnati Observatory at 8 o'clock.

Detroit: Dr. W. Carl Rufus, of the University of Michigan, will give an address on "Solar Systems, Fact and Fancy," at the October meeting of the Detroit Astronomical Society. The meeting is on October 13th, Sunday, at Wayne University, at 3:00 p.m. "Highlights of the October Skies" will be given by Ernest J. Kossow, and there will be observing with portable telescopes later in the evening.

Indianapolis: "The Navigation Stars" will be discussed by W. G. Gingery at the meeting of the Indiana Astronomical Society on October 6th, 2:15 p.m., at Odeon Hall.

Kalamazoo: At the meeting of the Kalamazoo Amateur Astronomy Association on October 12th at the home of Dr. and Mrs. L. N. Upjohn, 1556 Long Road, Dr. Upjohn will speak on "Mira."

Madison: The Madison Astronomical Society will hold its annual banquet on October 9th, time and place to be announced. Dr. Joel Stebbins, director of Washburn Observatory, will be guest speaker, his subject being "The Earth's Atmosphere and Its Effect on Astronomical Observations."

New York: "Astronomy and Navigation" will be the subject of the first lecture of the 20th season of the Amateur Astronomers Association. Gordon A. Atwater, of the Hayden Planetarium, is the speaker. The meeting will be in the Roosevelt Memorial building, American Museum of Natural History, on October 2nd at 8:00 p.m.

At the meeting of the Junior Astronomy Club, Friday, October 25th, at 8:00 p.m., Stanley Burrows, president of the club, will speak, his subject to be announced. This meeting is also in the Roosevelt Memorial building.

Philadelphia: At the meeting of the Rittenhouse Astronomical Society on Friday, October 11th, Dr. John B. Irwin, of the Flower Observatory, will speak on "Eclipsing Stars."

Pittsburgh: The Amateur Astronomers Association will have as its speaker John E. Roblee, engineer at the Westinghouse Corporation, at its October 11th meeting in the Buhl Planetarium at 8:00 p.m. Mr. Roblee will lecture on the basic principles of nuclear physics and will also show a Westinghouse motion picture, "Summer Storm," on electric power and electric service.

Classes in New York

Seven classes conducted by and for members of the Amateur Astronomers Association are scheduled to begin the second week of October. Further information on these classes may be had from the society's secretary, George V. Plachy, at the American Museum of Natural History, New York 24, N.Y. The courses and instructors are as follows:

Elementary Astronomy, W. Wallace Benjamin, Mondays; *General Physics*, Aileen A. Pindar, Tuesdays; *Intermediate Astronomy*, Edgar M. Paulton, Tuesdays; *Appreciation of Astronomy*, Peter A. Leavens and Hazel Boyd, 2nd and 4th Wednesdays; *Mathematics of Astronomy*, Max Trupin, Thursdays; *Advanced Astronomy* (seminar), Leon E. Gold, chairman, Fridays; *Telescope Mirror Making*, Messrs. Brown, Howland, Luce, Singer, and Thompson, three classes, Tuesdays, Wednesdays, and Thursdays.

Sunspot Observations

Roy A. Renner, of Grants Pass, Ore., has sent in a report of his observations of the sunspots late in July. He used a welder's helmet containing one No. 10 lens shade in combination with two pairs of ordinary dark glasses to get just the right intensity of the sun to observe it comfortably. With the otherwise unaided eye, he saw the large group of sunspots visible on July 29th.

Another method of observing with the naked eye which Mr. Renner thinks better is to look through one No. 10 welder's shade at the reflection of the sun on a second glass of the same kind. The glare is much lessened and the outline of the disk is sharp. He points out that any method involving a reflecting surface is somewhat confusing because of the reversal of the image.

Pittsburgh Picnic

The fifth annual basket picnic of the Amateur Astronomers Association of Pittsburgh was held at Riverview Park on August 17th. Approximately 90 persons attended, and after dark they visited Allegheny Observatory to examine the telescopes there. Cloudy weather unfortunately prevented the planned observations of the sky.

NEWS NOTES

By Dorrit Hoffleit

RESURRECTION OF THE JAHRESBERICHT

The *Astronomischer Jahresbericht* was an annual volume giving a bibliography of practically all astronomical literature, from all countries. To the research worker, in particular, this has been an indispensable reference source which covered the years from 1820 to 1941 (the last was actually published in 1943). Because of the importance of this bibliography, the International Astronomical Union encourages the German astronomers to resume its publication. Sir Harold Spencer Jones, president of the I.A.U., has recently been to Heidelberg to discuss plans for partial restoration of the Recheninstitut so that the work in question may be carried out.

The Institut should be supplied with copies of all astronomical papers published since 1941 (and many earlier, since the 1941 volume was necessarily incomplete). To facilitate delivery while communications in Germany are still uncertain, it is suggested that the literature be sent to Dr. Jones at the Royal Observatory, Greenwich, England, clearly marked "For the Recheninstitut," for forwarding by British naval authorities. American astronomers may, if they prefer, make shipments via the exchange service of the Smithsonian Institution, Washington, D.C.

INTERSTELLAR CLOUDS

In the Darwin lecture of the Royal Astronomical Society in England in May, Dr. Jan H. Oort, director of the Leiden Observatory, Holland, discussed Dutch wartime studies of the formation of solid particles in interstellar space.

The interstellar clouds appear to be quite irregularly distributed in space. In some directions as far as 10,000 parsecs stars are almost unobscured, while in other nearby directions similar stars cannot be seen farther away than 100 parsecs. On the average, the light from a star 1,000 parsecs distant will have to traverse five clouds containing both solid particles and gas. These clouds have motions on the order of 15 or 20 kilometers per second. Their diameters average about 100 parsecs, and Dr. Oort estimates that collisions between such clouds should occur about once every 10^7 years, producing unusual effects.

During such a collision, the compression of the region between the clouds would increase its temperature, to about three times the value in the rest of the clouds if their relative velocity was 30 kilometers per second. The hydrogen would become ionized, causing the region between the clouds to become luminous. If this interface happened to be approximately in a plane containing the line of sight from the earth, the phenomenon might resemble the Filamentary or Veil nebula in Cygnus.

Interstellar cloud collisions must cause evaporation of particles, a phenomenon opposite to the accretion of solid particles by condensation. Oort finds that the observed distribution of particles indicates that condensation alone is not operative, and that collisions between particles may frequently cause evaporation.

THE AGE OF THE EARTH

From time to time we have commented on astronomers' estimates of the age of the solar system or of the universe. Professor F. K. Morris, in the *Technology Review* (Massachusetts Institute of Technology), summarizes a geologist's estimate of the earth's age.

The oldest rocks for which ages are measured by the disintegration of their radioactive elements are about 1,500 million years old. But these are comparatively young granitic rocks, formed from hot solutions which encroached into or replaced the overlying layers. The geologist can show proof recorded in the older rocks that before such granitic invasions "the earth was as cool, as wet, as quiet, and as hospitable to life as it is today; that life itself was already old." To have arrived at that condition must have taken the earth a long time. From the astronomer, the geologist assumes that a hot earth existed prior to the present cool state—how long would this have taken to acquire its present rocky crust?

Professor Morris summarizes that the earth has existed essentially in its present form for 1,500 million years; and "a conjectural billion years for the transition from liquid to solid state; and a long era in which the earth was gaseous." Indefinite though the figures are, the age must approach 3×10^9 years. Professor Morris ventures that this "guess" is likely to be too low rather than too high.

EDDINGTON MEMORIAL LECTURES

The British journal, *Observatory*, announces that a number of distinguished sponsors are asking for funds to establish an Arthur Stanley Eddington Memorial lectureship. Describing Eddington as "one of the few recent scientific thinkers who have attempted to formulate a view of the world which would do justice to all fields of knowledge and experience," the sponsors hope to establish a foundation to attract lecturers in all related fields. The trustees of the foundation would represent the Royal Society, Trinity College, Cambridge, and the Society of Friends. The secretary of the Appeal Committee is Dr. W. H. Thorpe, Jesus College, Cambridge, England.

PRISM GOES TO MEXICO

An objective prism for the Schmidt telescope at the National Astrophysical Observatory at Tonanzintla in Mexico has been shipped from the Perkin-Elmer Corporation in Glenbrook, Conn., where the prism was ground and polished. It now weighs about 300 pounds and exceeds by three inches the diameter of the objective prism on the Schmidt telescope of the Warner and Swasey Observatory in Cleveland, Ohio.

RADIO BLACKOUT WARNING

Science Service reports on a new service rendered by the National Bureau of Standards, whereby semi-weekly predictions for reception from Europe for the next few days will be available, based on solar and atmospheric data. At 20 and 50 minutes past the hour, signals will be broadcast from WWV, the Bureau of Standards transmitting station; a Morse W (dot-dash-dash) will indicate that broadcasts from London, Stockholm, and Moscow will not come through clearly, and N (dash-dot) will promise clear reception.

This new service is the result of work by the Bureau of Standards, in which collecting of radio performance data from many sources and the correlation of this with solar observations, magnetic storms, and ionospheric conditions, has resulted in some success in the prediction of short-wave radio blackouts. Although this is still a comparatively new science, the records since April reveal that eight real storms disturbing foreign short-wave reception were correctly forecast, while only two that were predicted failed to materialize.

SMITHSONIAN CENTENNIAL

On August 10th, the Smithsonian Institution at Washington celebrated its 100th birthday. This research organization has charge of the National Museum, the National Zoological Park, the National Herbarium, the National Gallery of Art, the Freer Gallery of Art, the National Collection of Fine Arts, the Bureau of American Ethnology, and the Astrophysical Observatory of the Smithsonian Institution. It is a proud birthday for an organization so much concerned with our nation's culture and scientific advancement.

The Smithsonian Institution is the outgrowth of a bequest made by an Englishman who never even visited America.

The Velocities of Eruptive Prominences

By Helen B. Pettit, *Chabot Observatory*

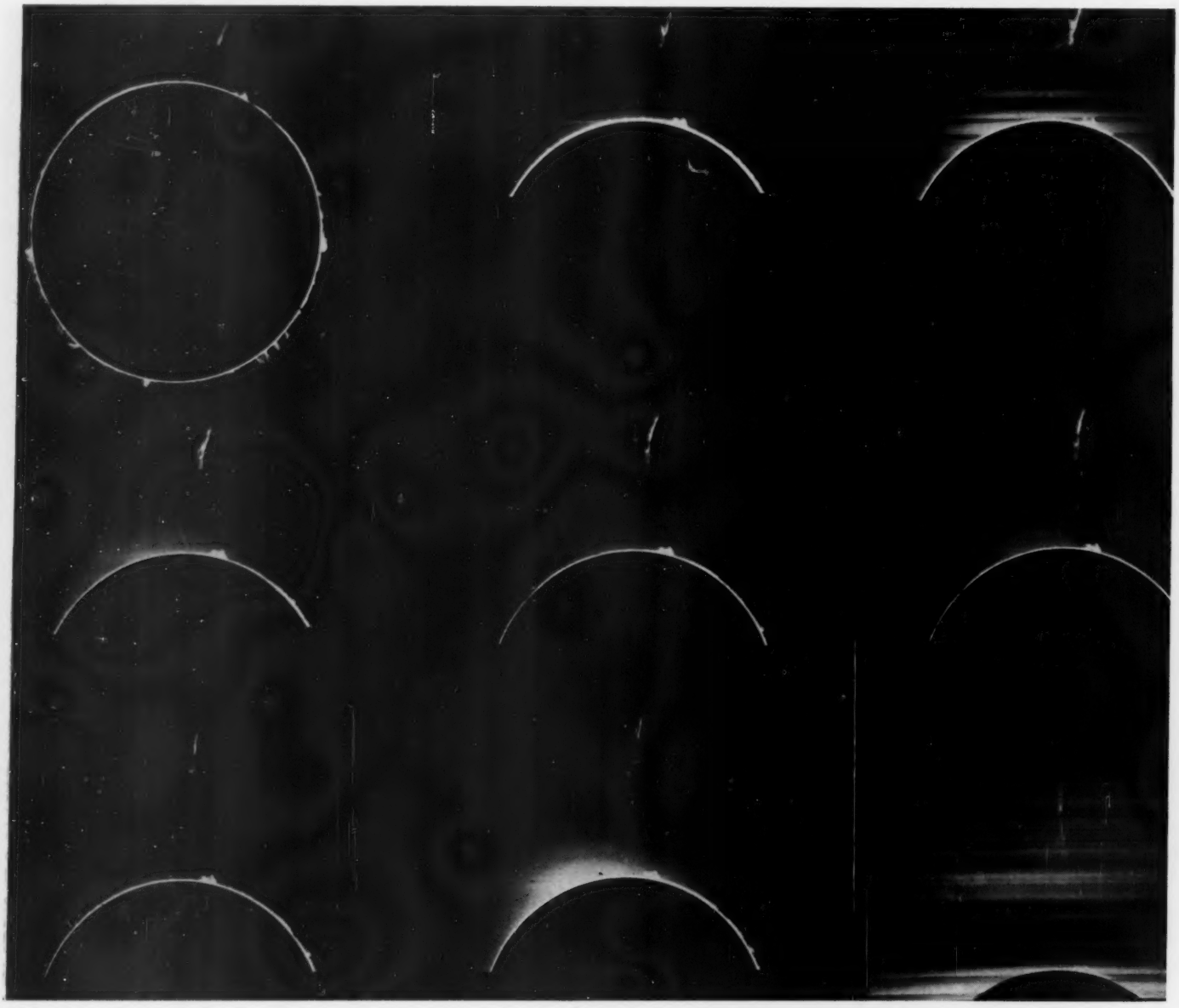
THIS EXPERIMENT, originally performed by the astronomy class at Pasadena Junior College, is based on Edison Pettit's laws of the motions of eruptive prominences. His laws state that such prominences move with a uniform velocity which increases suddenly at intervals, and that when the velocity changes, the new velocity is a simple multiple of the one next before. Thus, if a student had a series of pictures of an eruptive prominence, he would be able to determine its several velocities by measuring the height of the prominence from the limb of the sun and plotting it against the times at which the pictures were taken. Many such pictures are hard to measure, but for the student I have found Royds' set to be best suited.[1] Using these pictures, reproduced here, the following is an outline of the procedure.

1. First determine the scale of the picture. (a) Measure the length of any convenient chord of the solar disk, AC. (b) Divide it in half, a, and measure the perpendicular to the limb, h. (c) The diameter of the image is given by the formula $D = (a^2/h) + h$, which the student should be able to demonstrate by means of the Pythagorean theorem. (d) In this particular case, D can be measured directly since at least one picture is complete. (e) The diameter of the sun is given as about 1,393,000 kilometers. The prominences, however, arise from the chromosphere which, for practical purposes, is about 5,000 kilometers thick. Therefore, for the measurement of prominences we use 1,400,000 kilometers. (f) The value of one millimeter on the picture in units of 1,000 kilometers on the sun is then $1400/D$.

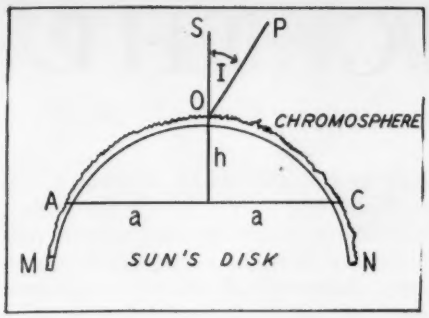
2. Determine the path OP which the prominence took upon leaving the sun (apparent trajectory), and the angle, I, at which it left the chromosphere.

(a) Place a piece of tracing paper on the first picture of the series of nine and trace the limb in the vicinity of the eruptive prominence as well as the prominence itself. Then place this same piece of paper on the next picture, adjusting it

[1] Monthly Notices R. A. S., 89, 255, 1928.



The eruptive prominence of November 19, 1928, photographed by Royds at the Kodaikanal Observatory in India. Times of observation in Indian standard time, reading from left to right and from top to bottom, are: 7:51.4, 8:32.7, 8:36.8, 8:42.7, 8:46.7, 8:50.7, 8:55.8, 9:01.3, 9:09.6.



until the small prominences in the vicinity of the eruptive one coincide. (If there are no other prominences, a series of lines can be drawn upon the tracing paper parallel to a line joining the ends of the arcs of the solar limb. Dust lines on the spectroheliograms can sometimes be used, also the bright streak tangent to the limb where the slit of the spectroheliograph moved off the sun.) Now trace the prominence again, repeating this process until all the pictures have been traced. Draw an average straight line connecting the top of the prominence in all the trajectory pictures, extending it down to the limb of the sun, which marks point *O*. Some eruptive prominences have a broken-line trajectory, whereas Royds' is a straight line so it is useful for instruction.

(b) To determine angle *I*, measure the angle which the trajectory makes with the normal *OS* drawn to the sun at the point *O* where the trajectory intersects the limb.

3. On each picture, measure the distance from *O* to the very topmost part of the prominence, using an accurate millimeter scale. Record each distance and the time at which each picture was taken.

4. Now multiply the figure obtained in 1(f) by each of your measurements in 3.

5. On a piece of graph paper plot the distance from *O* in 1,000-kilometer units as the vertical axis, and the time in minutes as the horizontal axis. Note that all the points do not lie in the same straight line, but that two straight lines will satisfy them.

6. Draw straight lines through the points on the graph. These straight lines will represent the average value, to account for observational errors.

7. To determine the velocity represented by each section of the broken line proceed as follows: From any convenient point on the line count over horizontally 16 2/3 minutes (1,000 seconds). Now count the distance vertically from this new point to the line (or the line extended). This will be the velocity, since the slope of the line is equal to the velocity. As 1,000 seconds is the horizontal distance, the vertical unit of 1,000 kilometers cancels out and the measure gives the result directly in kilometers per second. Repeat this for each graph section.

8. Compare your result with those of Edison Pettit, who obtained 81 and 200 kilometers per second; with the author's 80 and 184; and with a student's 85 and 195.

Note that the ratio of the velocities is 2.5; therefore, there may have been a third velocity at the beginning of the eruption, probably 40 kilometers per second, before Royds' pictures were taken. From this standpoint, the prominence illustrated is probably not the best for a student since the observations are incomplete, but the ease of measurement makes it suitable for an introduction.

In Focus

WITH THIS back-cover photograph, the series of nine plates on the first-quarter moon is completed. Here we have the northern side of the western limb of the moon. Features on this back cover and in the accompanying key chart will also be found on Plates II, III, and VIII, and corresponding In Focus items in the March, April, and September issues.

All named lunar features in this region are on the key chart. At this phase, identification of features near the limb is very difficult, and hence such objects are shown only in their approximate positions and sizes. Spellings follow the International Astronomical Union's **Named Lunar Formations**, by Blagg and Mueller, and bibliographical information is from the British Astronomical Association publication, **Who's Who in the Moon.**

Azout. A ring plain about 20 miles across, named for a 17th-century French astronomer and physicist.

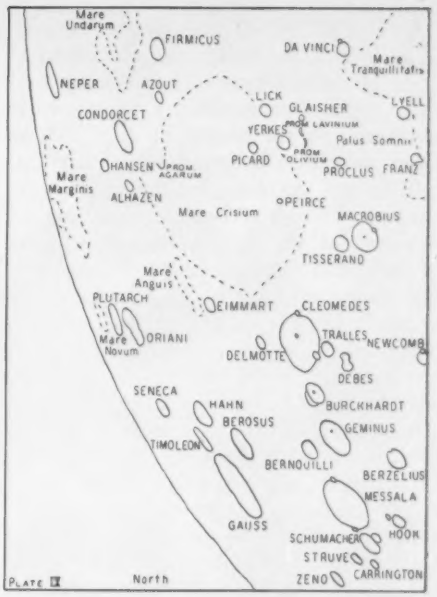
Berzelius. A ring plain with apparently low walls, named for the famous Swedish chemist who isolated titanium, zirconium, and other elements, and discovered selenium. He introduced the system of chemical nomenclature now in use.

Carrington. An inconspicuous ring plain. Richard Carrington was a keen solar observer, and made in the middle of the last century various contributions to our knowledge of the sun — its rate of rotation and the variation of the rate with latitude, the inclination of the sun's axis, the occurrence of sunspots in zones which vary with the 11-year spot cycle.

Da Vinci. Leonardo, famous Florentine artist (1452-1519), is also well known for his interest in physics and astronomy, and his work in architecture and engineering.

Franz. A bay-like formation on the edge of Mare Tranquillitatis. Julius Heinrich Franz was director of Breslau Observatory. His positions of formations near the lunar limb derived from photographs and heliometer measurements are used in the I.A.U. lunar atlas from which our identifications are made. He was also author of several books on the moon.

Gauss. Karl Friedrich Gauss (1777-1855) became one of the leading mathematicians of his time. He was director of Goettingen Observatory, which was built under his supervision. When he was 23 years old, he computed the position of Ceres which enabled this asteroid to be rediscovered late in 1801. Gauss also invented the magnetometer, and the unit of magnetism is named for him. On the moon, this formation, near the limb, is a large walled plain over 100 miles long.



Geminus. A walled plain with walls 15,000 feet above its interior, with a central peak which sometimes looks like a crater.

Hook. A small ring plain, named for the English mathematician, contemporary of Newton, whose name is usually given as Robert Hooke.

Macrobius. A walled plain about 40 miles across, with bright walls and a central mountain.

Mare Anguis. The Serpent Sea is really a narrow, winding plain. **Mare Crisium,** the Sea of Dangers, here appears in its entirety. It is one of the smaller lunar seas, and has well-defined walls. It is about 280 miles long by 350 miles wide. **Mare Marginis** and **Mare Novum.** The Border Sea and the New Sea, named by Franz, are near the lunar limb and not easily observed. **Mare Undarum** is the Sea of Waves.

Messala. A large walled plain, with considerable detail in its floor, but not easy to observe.

Neper. This is a large walled plain, but difficult to identify at this phase. The feature was named by Schreiner after John Napier (1550-1617), sometimes spelled Neper, Scottish mathematician and inventor of logarithms.

Newcomb. A small ring plain, named for the famous American mathematical astronomer (1835-1909), head of the Nautical Almanac Office.

Proclus. Proclus (410-485 A.D.) was a mathematician and the last great philosopher of the Neo-Platonic school. Some of his writings are of particular interest to historians for their comments on earlier astronomy and astronomers. This small crater is one of the brightest spots on the moon, and at certain illuminations rays may be seen emanating from Proclus.

Schumacher. A ring plain with a smooth floor, named for a Danish astronomer who studied under Gauss, worked at Mannheim and Copenhagen, founded the **Astronomische Nachrichten,** of which he edited the first 31 volumes.

NAMING THE C

By Henry I. Christ, *Amateur A*

AT PRESENT, nearly 90 constellations are recognized and accepted by astronomers. They have proved their right to recognition by successfully withstanding the buffets of time. Many other proposed constellations long ago fell by the wayside, but these have remained through a kind of selection or survival of the fittest. A great many of them can trace their origins back into the misty regions of prehistory. The versatile Greeks fixed about half of them pretty much in their present form, and the Romans transmitted them just about as they received them. Most constellations have Greek and Roman names, though star names are nearly all Arabic.

When a boy scout, studying for a merit badge in astronomy, goes out for the first time to learn the constellations, he invariably scratches his head in bewilderment. He is told that a group of stars represents Virgo, a maiden with a sheaf of wheat in her hand. By what stretch of the imagination, he asks himself, can anyone see a girl in these stars, much less some wheat, too? A too-literal mind invariably rejects the fanciful sky figures and turns to something more useful and "real." Yet, to our ancestors, these imaginary representations were more real than relativity is to most of us.

How did groups of stars come to be associated with particular objects? We can imagine how primitive man must have felt a sense of awe at gazing into the infinite — even modern men gain a sense of primeval wonderment as they look up into the vault of night. To the earliest stargazers, certain stars seemed to make patterns of things they knew. The Phoenicians, for example, saw in the sky a huge wheat field where we now put Andromeda and Cassiopeia. The primitive Australians, looking at the wreath of stars we call the Northern Crown, saw instead a boomerang. What more natural than to find analogies with familiar things? Indeed, many constellations today, even to a prejudiced eye, *do* look like the objects they represent. Scorpius, Leo, Draco, Sagitta — these are a few which we must agree are rightly named.

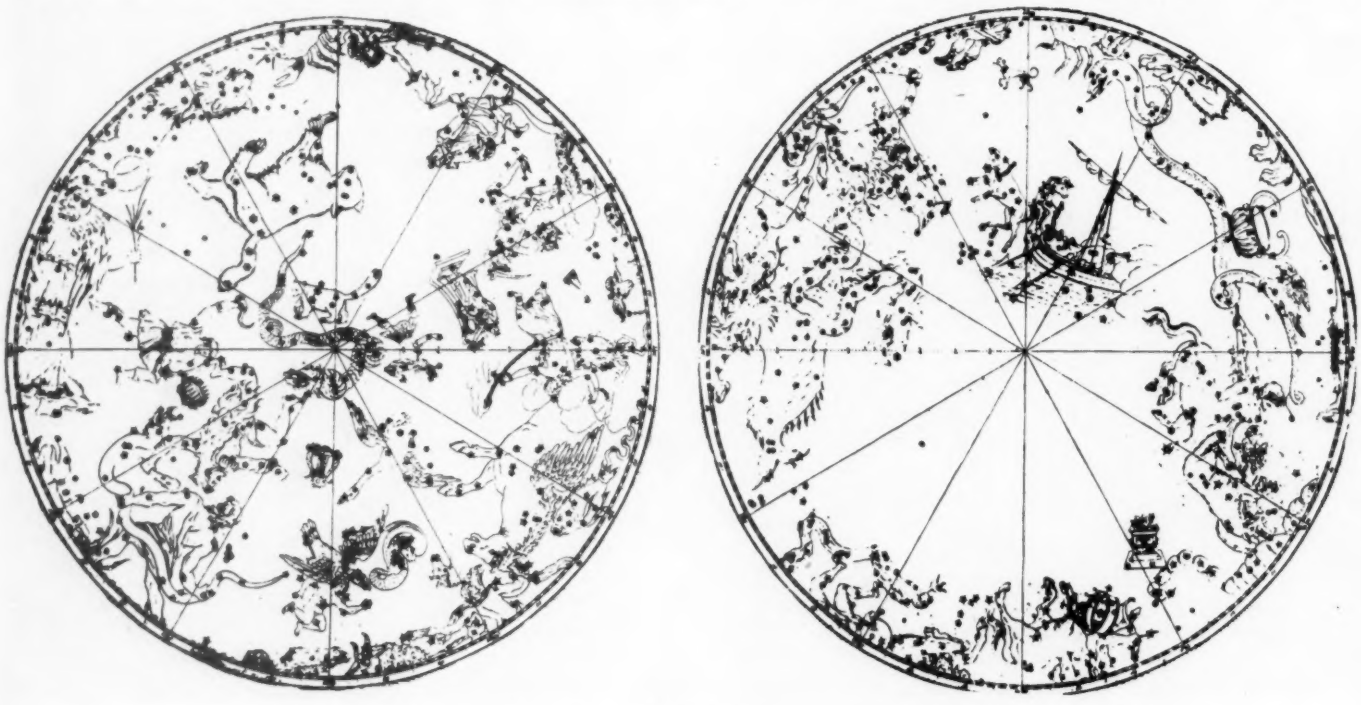
Different peoples saw different objects in a particular group of stars. Lyra, for example, has been called a harp, a bird, a ram, a turtle, even a mule. On the other hand, many constellations have fairly consistent names. Aquila has usually been associated with a bird and Draco with a dragon. Gemini, because so obviously twinned, has kept the pair or twin idea consistently. Sometimes constellation names were given, not according to appearance in the sky, but because of climatic associations. For example, stars associated with the rainy season were given names connected with water, rain, streams, or the sea.

A few star cataloguers are pre-eminent in constellation history. Two thousand years ago Ptolemy recorded 48 constellations for us; these we retain even today. In 1603 Bayer gave us 12 new star groups in the southern sky. Hevelius, in 1690, added about 10 more. The last new constellations were published in 1763 by Lacaille, the "Columbus of the southern sky," who added 14. Since then, despite many attempts, no new constellations have been successfully introduced except the division of Argo into several parts.

It is difficult to say why one constellation was accepted, another rejected. The eminence of the sponsor was certainly no guarantee of success. Halley tried unsuccessfully to add "Charles' Oak." Bode introduced many groups, not one of which is accepted today.

Only two methods of introducing new constellations were possible after Ptolemy's rather full listing: charting those in the southern sky which were undiscovered in Ptolemy's time; "borrowing" stars from existing constellations. Both methods were tried. Occasionally the ancient constellations had groups of "unformed" stars associated with them; many of these were made into constellations by Hevelius. Sometimes, though, ambitious constellationists made borrowings that aroused other astronomers. When Halley borrowed some of Argo's best stars to make Charles' Oak, Lacaille objected strenuously. The "loan" was paid back. Successful carvings from the hearts of old groups have been made, though. Libra was once the claws of the Scorpion, and four groups were made out of Argo.

The explorations of the 15th and 16th centuries brought new horizons and new



Star charts drawn about 200 years ago, but based on information in Ptolemy's catalogue, show the blank region around the south celestial pole which Ptolemy and his contemporaries never observed. Into this comparatively small area were later put about one quarter of the 88 constellations we know today.

CONSTELLATIONS

ateur Astronomers Association, New York

unmapped stars. No explorer setting foot on an unknown shore was more thrilled than astronomers seeing the southern skies for the first time. Bayer's listings were in the tradition of the ancients — his new groups were mostly animals and birds. Lacaille, however, a century and a half later cluttered up the yet uncharted southern regions with all kinds of astronomical equipment. Groups of dim stars, unworthy of separate recognition, were formed into distinct constellations to plague amateur astronomers below the equator. Yet all these have been retained, although easy-to-see northern asterisms such as the Bull of Poniatowskia have been dropped.

Occasionally, a sly astronomer tried to slip a new constellation into an already occupied spot. Lacerta, the Lizard, was put into a place reserved by Royer for the Scepter and Hand of Justice. A century later Bode tried to put Frederick's Glory in nearly the same spot. Lacerta won out finally.

Some constellations were introduced to flatter or honor a monarch. Frederick's Glory commemorated Frederick II of Prussia, while Royer's Scepter honored Louis XIV. Halley's introduction of Charles' Oak — to flatter Charles II — won him a master's degree from Oxford! All these groups were rejected in time. A personal tribute that has been retained, however, is Sobieski's Shield (Scutum) in honor of the Polish hero who fought the Turks.

A list of forgotten constellations would be a long one, including such animals as a cat, a flamingo, a turtle, a reindeer, a night owl, and a solitary thrush; and such objects as a printing office, an electric machine, a balloon, a solarium, a scepter, and a quadrant. Some were retained for a while; others never gained acceptance. At least one constellation won out after long neglect. Coma Berenices, not accepted as a separate constellation for many centuries, at last was admitted as a full-fledged entity. Contrary to popular belief, the Pleiades and the Hyades are still not separate constellations, but merely adjuncts to Taurus, the Bull.

Some of our ancient constellations have been given new significance. Cygnus is more commonly called the Northern Cross than the Swan. It is the Southern Cross, though, which has the more fascinating history. Because of precession of the equinoxes, Centaurus was visible in ancient Greece whereas now only a fraction of it can be seen at such latitudes. In Centaurus was a group of four stars, beautiful, but not separately named. Then Centaurus began to slip below the horizon — the four stars were just visible on the horizon at Jerusalem at the time of the Crucifixion. Thereafter the stars gradually disappeared to northern eyes. When the great navigations took place and Christian explorers began to see southern skies for the first time, lo and behold, there was a cross, the same stars that once were considered part of the Centaur! Now they had a new significance and the Southern Cross, most famous object in the southern sky, came into its own. It will once again be visible in the latitude of New York — but not for thousands of years. Present-day New Yorkers must go at least as far south as Miami to glimpse all of the stars in Crux.

A celestial globe made of silver, showing the mythological figures, and attributed to Tycho Brahe. While the northern constellations were well known by this time, the far southern ones had not yet been named.

Christian attempts to remap the sky have been numerous. In vain the Venerable Bede suggested over a millennium ago that the zodiac be changed to admit the Twelve Apostles. Julius Schiller, in the 17th century, attempted to people the sky with popes, bishops, saints, without success. If some of these innovators had had their way, Draco would now be Eve's serpent, Leo one of Daniel's lions, and Aquarius John the Baptist.

Other secular changes have been suggested from time to time, but these attempts have failed. Weigelius, for example, sought to introduce the coats of arms of European dynasties. Only a few years ago, A. P. Herbert attempted a wholesale remapping along contemporary lines. Draco became the Tyrants, with Robespierre, Tamburlaine, Mussolini, Hitler, Attila, and Kubla Khan enshrined therein. The Big Dipper became Great Britain, with British heroes appropriately remembered, and so on. His thesis, that every generation should rename its own sky, is interesting, but seemingly destined to disappointment.

As in so many other things, the people — laymen as well as astronomers — decide these problems; they sort out and eliminate. They have their own familiar names for the ancient constellations (the Big Dipper and Job's Coffin, for example), but they retain the ancient associations, too. Hitler will be just a name a few years hence, but the stories clustering about Draco are grounded in the culture of Western civilization.

Wholesale recharting of the sky has never succeeded. The people have a nice "feel" for these things. They are at their most poetic in naming flowers and stars. What more perfect than the folk descriptions of the galaxy: the Milky Way, the Stream of Ocean, the River of Heaven, the Ashen Path? Artificially fostered systems don't last. Perhaps it's just as well.

★ ★ ★ ★ ★ ★ ★ ★

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★ ★ ★ ★ ★ ★ ★ ★

BOOKS AND THE SKY

STAR ATLAS AND NAVIGATION ENCYCLOPEDIA

S. S. Rabl. Cornell Maritime Press, New York, 1946. 161 pages. $5.00.

THIS BOOK contains so many inexcusable errors that the reputation of the publishers will suffer. Correct navigation means life where incorrect navigation frequently may lead to death. An attractive format and an entertaining style only set a trap for the unwary beginner if the substance of a text is not wholly reliable.

The title's assertion of the status of a "navigation encyclopedia" is ludicrous. Air navigation is scarcely mentioned, nor are many matters of critical importance in marine navigation, for instance, buoyage, lights, tides, relative motion. Much that is treated is touched upon too lightly to be intelligible. The sketchy and not altogether accurate discussion of loran, for example, is not enough to justify a claim of "up-to-the-minute" modernity.

The 12 full-page star charts, with white stars and lettering on a dark blue background, are good. The reader is told that they represent the celestial sphere on "a method developed by the author." The projection is not identified by name, but it is the well-known transverse Mercator, which has been applied to the stars at least once before in a familiar text. Rabl's charts are on a scale nearly twice the scale of those of Stewart and Pierce, but extend only 30 degrees on either side of the central hour circle instead of 60 degrees. Northern and southern celestial hemispheres are separated on facing pages, with sufficient overlap across the equator.

Names of the constellations are shown, and of a number of stars in addition to the 55 navigators' stars, but the names of not quite all the latter are printed. In the legend of each of the 12 charts, 12:30 p.m. is written where 12:30 a.m. is meant. In the general explanation the ridiculous term, "hour circles of declination," appears, and there is no discussion of the effect of the observer's latitude, and an inadequate one of the effect of time.

In another part of the book the principal constellations are depicted again in large-scale diagrams, with original drawings by the author of the mythological figures. Perhaps by some readers these will be considered more charming than the standard ones of the Bayer atlas. Rabl does not feel bound to fit his figures to the individual bright stars, and so they have a pleasant if arbitrary freedom. True to the ecstatic description of the publisher, Andromeda and Aquarius are depicted as "beautiful nudes," but not even a female "Aquarius" justifies the price of the book.

Unfortunately, few books on navigation published outside the Nautical Almanac Office are free from errata, but the following examples of the "encyclopedic" information presented by Mr. Rabl suggest that the publishers should withdraw the book.

"The earth is one of seven planets." Mars has "six moons." "Above our atmosphere is the ether, of whose exact composition very little is known at present." The **American Air Almanac** "is published to cover two months at a time." "The arc of the celestial sphere, intersected between the heavenly body and the zenith on the lune or hour circle of the observer, is the zenith distance." "Navigators use apparent time for their observations." "The stereographic projection is the representation of one-half of the globe's surface within a circle. It is not a projection in the true sense of the word." "All

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THE BOOK CORNER

Hayden Planetarium - New York 24, N. Y.

modern navigation tables are based on obtaining the intercept. The line of position is only retained and used should a fix from more than one body be required."

The book seems to be almost completely free from ordinary errors of proofreading, and mechanical details of its manufacture are well executed. This is too bad!

JOHN Q. STEWART
Princeton University Observatory

GERMAN FOR THE SCIENTIST

Peter F. Wiener. Additional sections by **Paul Spoerri.** Chemical Publishing Company, Brooklyn, N. Y., 1946. 238 pages. $3.50.

A HUNGARIAN ACTOR I used to know once addressed a petition for divorce to the Budapest court. I will always remember the puzzled expression of his face when a few days later he received a reply, duly styled in the best legal language, from which he vainly tried to figure out whether the court had accepted his petition or not.

Scientific German may not be quite so abstruse as legal Hungarian, but it is a fact that there are at least some German scientists who prefer to read English rather than German scientific papers. Under such circumstances, a book like Mr. Wiener's should be more than welcomed by American students of physics, chemistry, and allied sciences.

Since the mastery of a language is largely a subconscious process, there is no real substitute for the tedious mechanism of repetition in trying to acquire the grammatical rudiments which in a highly flexible language, such as German, are indispensable even to recognize individual words. It therefore strikes us as rather optimistic to hope with the author that the student will be ready to chew on full-fledged articles by Planck and Einstein after six short grammar lessons without any progressive exercises, and after a little Andersen tale interpolated between lessons with vocabulary and translation. Apart from its succinctness, however, the grammatical introduction is remarkably effective, and we recommend it as a preliminary refresher to the students who will most commonly use this book — those who have unsuccessfully struggled for a year with elementary German. To those who are entirely new to German, we suggest taking first a few lessons of the orthodox type ("My book is smaller than your uncle's orchard," and so on).

The brief grammatical introduction is followed by a first-class selection of 18 chemistry and 14 physics papers by eminent authors, with English translations in a special appendix (perhaps a side-by-side translation would have been handier, but that is a matter of personal taste). If you have the persistence to read them through, you will have little difficulty in reading any German scientific paper for the rest of your life. Thirty-four pages of vocabulary, containing all German words used in the texts, complete the book.

LUIGI JACCHIA
Massachusetts Institute of Technology

MASON AND DIXON AGAIN

THOMAS D. COPE, author of the article on Charles Mason and Jeremiah Dixon which was briefly reviewed in the August issue (page 2), writes the editors that for a book in preparation he is in quest of further information about these two interesting characters, and states that any information which **Sky and Telescope** readers may have or may be able to find about the following points will be gratefully acknowledged and duly credited. Dr. Cope may be addressed at the Morgan Laboratory of Physics, University of Pennsylvania, Philadelphia 4, Pa.

1. Is there any record of Charles Mason's education and training before he became assistant observer at Greenwich in 1756?

2. Where were Mason and Jeremiah Dixon between the time of their return from St. Helena in 1762 and the summer of 1763, when Lord Baltimore and Thomas and Richard Penn engaged them to come to America? And what were they doing in this interval?

3. Who brought them to the attention of Lord Baltimore and the Penns? Presumably Dr. John Bevis. Were there others?

4. Mason was employed by the Commissioners of Longitude to work for the **Nautical Almanac.** Where did he live while thus employed? Where is the record of this employment?

5. Mason signed his Lunar Tables at Sapperton, Gloucestershire, on May 23, 1780. Was Sapperton his home or had he located there temporarily in order to be near the manuscripts of Rev. James Bradley?

6. What were the circumstances that led Mason to leave England during the 1780's and to return to Philadelphia where he died during October, 1786?

7. What was Dixon doing during the 1770's? He returned from Hammerfest in 1769, was elected a fellow of the Royal Society in 1773, and died at his paternal home in the county of Durham in 1779.

8. An astronomical clock used by Mason and Dixon is owned by the Royal Society. A telescope is kept in Philadelphia. Are other instruments used by them still preserved, and if so, where are they?

NEW BOOKS RECEIVED

A PRIMER FOR STAR-GAZERS, *Henry M. Neely,* 1946, *Harper.* 334 pages. $3.75.

A brand new approach to constellation study; the first book in a long while devoted exclusively to identifying the stars and to discussing the features of the heavens constellation by constellation.

PHOTOMETRIC ATLAS OF STELLAR SPECTRA, *W. A. Hiltner* and *Robley C. Williams,* 1946, *University of Michigan Press.* Unpaged. $7.50.

Tracings made with a direct-intensity microphotometer of the spectra of eight stars. The spectra were taken with the 82-inch McDonald Observatory reflector.

THE WORLD OF NUMBERS, *Herbert McKay,* 1946, *Macmillan.* 198 pages. $2.50.

A readable book on mathematics, of particular interest to amateur astronomers, by the author of *Odd Numbers.*

Planetarium Notes

ADLER PLANETARIUM

900 E. Achsah Bond Drive, Chicago 5, Ill., Wabash 1428

SCHEDULE: Mondays through Saturdays, 11 a.m. and 3 p.m.; Sundays, 2:30 and 3:30 p.m.

STAFF: *Director,* Wagner Schlesinger. *Other lecturer:* Harry S. Everett.

October: THE MIDNIGHT SUN. A trip to the Arctic Circle and the North Pole shows the midnight sun and the polar skies with six months day and six months night.

November: THE MOON AND ECLIPSES.

BUHL PLANETARIUM

Federal and West Ohio Sts., Pittsburgh 12, Pa., Fairfax 4300

SCHEDULE: Mondays through Saturdays, 3 and 8:30 p.m.; Sundays and holidays, 3, 4, and 8:30 p.m.

STAFF: *Director,* Arthur L. Draper. *Other lecturers:* Nicholas E. Wagman, J. Frederick Kunze.

October: COLORS IN THE SKY. Visitors see the strange colors of eclipses, the vivid tints of the northern lights, and the significant colors concealed in planets and stars.

November: POETRY OF THE STARS and ECLIPSES—PAST AND FUTURE.

FELS PLANETARIUM

20th St. at Benjamin Franklin Parkway, Philadelphia 3, Pa., Rittenhouse 3050

SCHEDULE: 3 and 8:30 p.m. daily; also 4 p.m. on Saturdays, Sundays, and holidays. 11 a.m. Saturdays, Children's Hour (adults admitted).

STAFF: *Director,* Roy K. Marshall. *Other lecturers:* I. M. Levitt, William L. Fisher, Armand N. Spitz, Robert W. Neathery.

October: COMETS AND METEORS. The possibility that on October 9th of this year the Giacobinids will provide a spectacular meteor shower is reason enough for discussion of meteors and their connection with comets.

November: THROUGH GREAT TELESCOPES.

GRIFFITH PLANETARIUM

P. O. Box 9866, Los Feliz Station, Los Angeles 27, Cal., Olympia 1191

SCHEDULE: Friday and Saturday, 3 and 8:30 p.m.; Sunday at 3, 4:15, and 8:30 p.m.

STAFF: *Director,* Dinsmore Alter. *Other lecturers:* C. H. Cleminshaw, George W. Bunton.

October: THE MILKY WAY. The Milky Way is the light from billions of faint stars composing our galaxy; the Magellanic Clouds and Andromeda nebula are other galaxies.

November: THE MOON.

HAYDEN PLANETARIUM

81st St. and Central Park West, New York 24, N. Y., Endicott 2-8500

SCHEDULE: Mondays through Fridays, 2, 3:30, and 8:30 p.m.; Saturdays, 11 a.m., 2, 3, 4, 5, and 8:30 p.m.; Sundays and holidays, 2, 3, 4, 5, and 8:30 p.m.

STAFF: *Honorary Curator,* Clyde Fisher. *Chairman and Curator,* Gordon A. Atwater. *Other lecturers:* Robert R. Coles, Catharine E. Barry, Shirley I. Gale, Edward H. Preston.

October: AUTUMN CONSTELLATIONS. With time condensed we will witness the march of the autumn constellations as the earth turns eastward on its axis and the night passes.

November: FROM ONE PLANET TO ANOTHER.

OBSERVER'S PAGE

Greenwich civil time is used unless otherwise noted.

A Month for Meteors and Occultations

THE MOON will both hinder and help amateur observations of celestial events this month. On the 10th, full moonlight will impair observations of the expected Giacobinid meteor shower, described in the article by Dr. Fletcher G. Watson in this issue.

Another meteor shower, the Orionids, reaches its maximum about the 19th of the month, but some meteors can be seen from the 15th through the 24th. Their radiant is seven degrees north of Betelgeuse, close to Nu Orionis. These meteors are associated with the orbit of Halley's comet.

A large number of occultations are predicted, many of them listed here. Note the occultation of Uranus on the 14th, in the northern and western states and in Canada. Elsewhere, a close conjunction between the moon and the planet will be observed.

6-7 **161 B Capricorni** 6.4, 21:59.2 —18-09.8, 12, +72° 0° Im: **A** 3:41.9 —1.5 —0.5 76°; **B** 3:39.2 —1.3 —0.3 68°; **C** 3:35.5 —1.8 —0.3 77°; **D** 3:31.2 —1.5 +0.1 63°; **E** 3:11.5 —1.7 +0.8 53°; **F** 2:48.0 —2.2 +1.1 62°; **G** 2:59.3 —0.8 +2.0 9°; **H** 2:18.1 —1.5 +2.3 33°; **I** 2:48.4 ... ... 4°.

7-8 **69 Aquarii** 5.8, 22:44.8 —14-20.5, 13, +76° +13° Im: **A** 23:27.5 —1.2 +1.6 65°; **B** 23:31.2 —1.1 +1.7 61°; **C** 23:16.2 —1.1 +1.6 69°; **D** 23:21.7 —1.0 +1.7 62°; **E** 23:05.6 —0.7 +1.7 69°; **F** 22:48.6 —0.3 +1.0 92°.

7-8 **Tau Aquarii** 4.2, 22:46.7 —13-52.7, 13, +76° —5° Im: **A** 1:11.8 —0.8 +2.3 13°; **B** 1:18.2 —0.5 +2.4 6°; **C** 0:59.1 —1.0 +2.6 14°; **D** 1:10.9 ... ... 359°; **E** 0:52.5 ... ... 354°; **F** 0:10.8 —1.1 +2.8 23°.

11-12 **Xi Arietis** 5.5, 2:21.9 +10-22.0, 17, +78° —9° Em: **A** 6:02.1 —1.5 +1.0 237°; **B** 6:03.0 —1.5 +0.7 246°; **C** 5:50.9 —1.5 +1.3 235°; **D** 5:52.3 —1.6 +0.9 250°; **E** 5:29.1 —1.7 +1.0 261°; **F** 5:05.7 —1.5 +1.4 251°; **H** 4:36.3 —2.0 —0.9 311°.

14-15 **URANUS** 5.9, ... , 20, +90° +15° Im: **E** 6:03.5 —1.6 —0.1 125°; **H** 5:42.6 +0.1 +1.0 90°. Em: **B** 7:04.0 ... ... 186°; **D** 6:55.9 ... ... 189°; **E** 6:43.3 +0.1 +3.4 200°; **G** 6:59.6 —0.4 +1.6 259°; **H** 6:34.1 +0.1 +1.7 237°; **I** 6:54.7 —0.2 +1.4 266°.

14-15 **121 Tauri** 5.3, 5:32.2 +24-00.3, 20, +57° —9° Em: **A** 12:09.8 —0.9 —1.6 283°; **C** 12:09.4 —1.3 —1.0 268°; **E** 11:47.5 —1.8 —0.5 265°; **F** 11:27.1 —2.2 +2.0 226°; **G** 10:53.9 —2.1 —2.5 317°; **H** 10:49.0 —2.0 +0.7 264°; **I** 10:36.8 ... ... 324°.

15-16 **Epsilon Geminorum** 3.2, 6:40.6 +25-11.2, 21, +55° —4° Im: **F** 12:57.8 —2.0 —1.6 114°; **G** 12:34.0 —1.5 +2.8 37°; **H** 12:03.9 —2.1 +0.3 93°; **I** 12:17.7 —1.2 +2.7 41°. Em: **F** 14:14.6 —1.8 —0.3 258°; **G** 13:20.0 —1.3 —3.1 323°; **H** 13:27.9 —2.2 +0.2 263°; **I** 13:09.9 —1.7 —2.2 315°.

16-17 **176 B Geminorum** 6.3, 7:35.0 +24-29.0, 22, +70° +3 Em: **A** 10:02.2 —1.9 +1.4 248°; **B** 10:03.5 —1.8 +0.8 259°; **C** 9:46.7 —1.8 +2.6 233°; **D** 9:51.4 —1.7 +1.4 252°; **E** 9:27.8 —1.3 +2.0 245°; **F** 8:53.2 0.0 +4.3 208°; **G** 9:17.4 —0.8 +0.6 298°; **H** 8:58.6 —0.4 +1.3 263°; **I** 9:09.6 —0.7 +0.5 304°.

16-17 **181 B Geminorum** 6.0, 7:35.9 +24-20.8, 22, +80° +9° Em: **A** 10:20.0 ... ... 213°; **D** 10:11.6 —1.7 +3.6 220°; **E** 9:38.7 ... ... 203°; **G** 9:47.4 —0.7 +1.4 268°; **H** 9:16.7 0.0 +2.5 229°; **I** 9:39.8 —0.5 +1.3 272°.

16-17 **Kappa Geminorum** 3.7, 7:41.2 +24-31.7, 22, +56° —8° Im: **E** 11:40.8 —2.1 +0.1 92°; **F** 11:33.1 —2.4 —1.9 131°; **G** 11:20.7 —0.9 +3.0 46°; **H** 10:47.4 —1.3 +0.8 95°; **I** 11:09.4 —0.6 +3.1 45°. Em: **E** 13:02.7 —1.8 —1.2 287°; **F** 12:47.7 —2.8 +1.4 245°; **G** 12:10.1 —1.5 —1.8 321°; **H** 12:04.3 —1.8 +0.9 267°; **I** 11:58.0 —1.6 —1.2 319°.

29-30 **Sigma Sagittarii** 2.1, 18:51.9 —26-21.9, 5, +64° +16° Im: **A** 21:26.6 —2.2 —0.3 96°; **C** 21:16.9 —2.4 —0.2 101°; **E** 20:46.9 —1.9 +0.4 104°; **H** 20:19.6 +0.4 —1.2 153°. Em: **A** 22:55.5 —1.7 —0.5 255°; **B** 22:52.0 —1.7 —0.7 260°; **C** 22:48.5 —2.0 —0.2 253°; **D** 22:42.3 —1.9 —0.4 262°; **E** 22:18.0 —2.3 +0.2 260°; **H** 21:04.7 —2.5 +3.0 225°.

For selected occultations (visible at three or more stations in the U. S. and Canada under fairly favorable conditions), these predictions give: evening-morning date, star name, magnitude, right ascension in hours and minutes and declination in degrees and minutes, moon's age in days, limiting parallels of latitude, immersion or emersion; standard station designation, GCT, a and b quantities in minutes, position angle; the same data for each standard station westward.

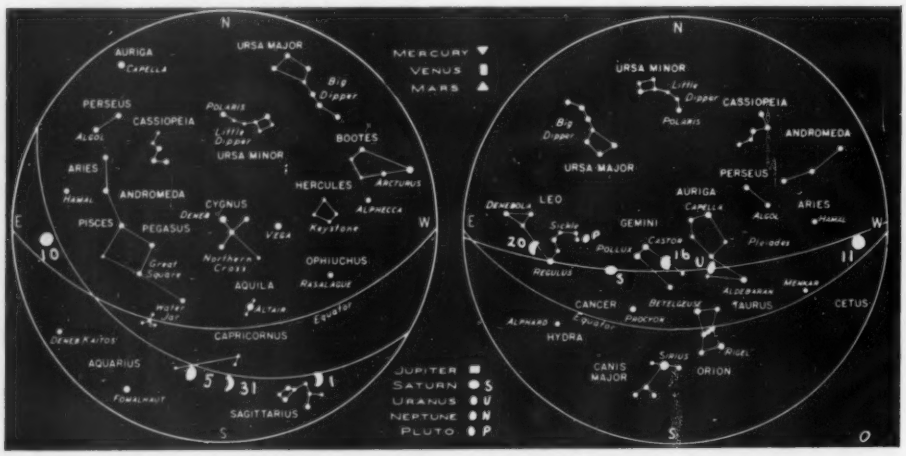
Longitudes and latitudes of standard stations are:

A +72°.5, +42°.5	**E** +91°.0, +40°.0
B +73°.6, +45°.6	**F** +98°.0, +30°.0
C +77°.1, +38°.9	**G** +114°.0, +50°.9
D +79°.4, +43°.7	**H** +120°.0, +36°.0
	I +123°.1 +49°.5

The a and b quantities tabulated in each case are variations of standard-station predicted times per degree of longitude and of latitude respectively, enabling computation of fairly accurate times for one's local station (long. Lo, lat. L) within 200 or 300 miles of a standard station (long. LoS, lat. LS). Multiply a by the difference in longitude (Lo — LoS), and multiply b by the difference in latitude (L — LS), with due regard to arithmetic signs, and add both results to (or subtract from, as the case may be) the standard-station predicted time to obtain time at the local station. Then convert the Greenwich civil time to your own standard time.

For additional occultations consult the American Ephemeris and Nautical Almanac and the British Nautical Almanac, from which these predictions are taken. Texas predictions were computed by E. W. Woolard and Paul Herget.

THE MOON AND PLANETS IN THE EVENING AND MORNING SKIES



In mid-northern latitudes, the sky appears as at the right at 5:30 a.m. local time on the 7th of the month, and at 4:30 a.m. on the 23rd. At the left is the sky for 7:30 p.m. on the 7th and 6:30 p.m. on the 23rd. The moon is shown for certain dates by symbols which give roughly its phase. Each planet has a special symbol, and is located for the middle of the month, unless otherwise marked. The sun is not shown, although at times it may be above the indicated horizon. Only the brightest stars are included, and the more conspicuous constellations.

Mercury reaches greatest eastern elongation on October 31st, 23° 44′ distant from the sun. This is the poorest evening elongation all year, as Mercury sets less than one hour after sunset on the 31st. Its magnitude will be 0.0.

Venus is at greatest brilliancy on October 13th, —4.3, but it will not be conspicuous for north latitude observers, as it sets only an hour and a quarter after the sun. By the 31st, Venus will set 40 minutes after sunset, and it will disappear from naked-eye view several days later. In a telescope it will then appear as a thin crescent 40 seconds of arc across. It will continue to increase in apparent diameter and to grow thinner until conjunction with the sun on November 17th.

Mars and **Jupiter** will not be visible due to their proximity to the sun. Jupiter is in conjunction with the sun on October 31st.

Saturn is a morning object, rising about midnight local time. The stellar magnitude is +0.5 all month.

Uranus remains in western Taurus and rises about three hours after the sun has set. A close conjunction with the moon occurs on the 15th, with the planet 0° 43′ south in geocentric declination at 7:31 GCT. An occultation will be seen in the mid-west and west. Uranus is of magnitude 5.9 and its position is $5^h\ 24^m$, +23° 15′ (1946).

Neptune is in conjunction with the sun on the 2nd and hence not visible. E. O.

GREENWICH CIVIL TIME (GCT)

TIMES used on the Observer's Page are Greenwich civil or universal time, unless otherwise noted. This is 24-hour time, from midnight to midnight; times greater than 12:00 are p.m. Subtract the following hours to convert to standard times in the United States: EST, 5; CST, 6; MST, 7; PST, 8. If necessary, add 24 hours to the GCT before subtracting, and the result is your standard time on the day preceding the Greenwich date shown.

PHASES OF THE MOON

First quarter ..... October 3, 9:53
Full moon ..... October 10, 20:40
Last quarter ..... October 17, 13:28
New moon ..... October 24, 23:32
First quarter ..... November 2, 4:40

MINIMA OF ALGOL

October 2, 18:25; 5, 15:14; 8, 12:03; 11, 8:51; 14, 5:40; 18, 2:29; 20, 23:18; 23, 20:06; 26, 16:55; 29, 13:44. November 1, 10:33; 4, 7:22.

VARIABLE STAR MAXIMA

These predictions of variable star maxima are made by Leon Campbell, recorder of the A.A.V.S.O., Harvard College Observatory, Cambridge 38, Mass. Serious-minded observers interested in making regular telescopic observations of variable stars may write to Mr. Campbell for further information.

Only stars are included here whose mean maximum magnitudes, as recently deduced from a discussion of nearly 400 long-period variables, are brighter than magnitude 8.0. Some of these stars, but not all of them, are nearly as bright as maximum two or three weeks before and after the dates for maximum. The data given include, in order, the day of the month near which the maximum should occur, the star name, the predicted magnitude, and the star designation number, which gives the rough right ascension (first four figures) and declination (bold face if southern).

October 6, T Cassiopeiae, 7.8, 001755; 15, RT Hydrae, 7.6, 082405; 16, S Carinae, 5.7, 100661; 17, RS Librae, 7.7, 151822; 18, R Andromedae, 7.0, 001838; 21, R Carinae, 4.6, 092962; 21, R Virginis, 6.9, 123307. November 2, T Centauri, 6.1, 133633.

MOUNTAINTOP FOR SALE

According to *Time* magazine, the mountaintop on which is located Mount Wilson Observatory is for sale. Terms of the Carnegie Institution lease are said to include the provision that the observatory keep its grounds open to visitors. Albert C. Childs, present owner, began in 1922 to develop the mountain as an attraction for visitors. According to *Time*:

"Childs cut down hotel expenses, improved the toll road, built a swimming pool and picnic grounds, and advertised. He soon had the hotel in the black. When hotel guests began to ask questions about astronomy, Childs built a lecture room, bought a twelve-inch telescope, and began giving evening lectures in elementary astronomy. . . ."

Mount Wilson is now proving useful for the location of television and FM broadcasting stations. Owner Childs offers the mountain for $425,000 to Los Angeles County, but $600,000 to anyone else. He wants to see the world and then settle down to astronomy — his hobby.

AMERICAN ASTRONOMERS REPORT

(Continued from page 8)

of Harvard, has obtained contact prints of the two original Cape Observatory plates, through the kindness of the Kapteyn Astronomical Laboratory at Groningen, Holland. The two images identified as Y Ceti turn out to be those of two stars in Sagittarius, for each plate bears two exposures, one on Cetus and one on a region in Sagittarius. This is a case of mistaken identity and Y Ceti is therefore nonexistent.

Rho Cassiopeiae

TWO PAPERS, one by Daniel M. Popper, of Yerkes Observatory, and the other by the Gaposchkins and Margaret Mayall, of Harvard College Observatory, dealt with the peculiar changes in light and spectrum of the irregular variable star Rho Cassiopeiae.

In June this year, the star had faded to the 6th magnitude, as compared to its normal range of 4.7 to 5.1, the decrease in light having taken place gradually from about November, 1945. In June the spectrum resembled that of Mu Cephei, a supergiant star of spectral class *M*2, whereas in 1940 the star was classified as *F*8. A spectrogram obtained in August, 1944, before the light had started to fade, shows that the spectroscopic changes were already under way, although bands of titanium oxide characteristic of *M* stars had not yet appeared. These bands were weakly present, however, in October, 1945, shortly before the decline in light started.

It has been known for many years that Rho Cass was much redder than any other *F*-type star. But although its spectrum resembled that of Mu Cephei in June this year, Rho Cass was much less red than that *M* star, so that its color did not change markedly during the decline in light. Mr. Popper concluded his paper by describing the principal differences in the spectra of the two stars. He pointed out that in the ultraviolet region also, Rho Cass resembles an *M* star much more than it does an *F*8 supergiant.

The work by the Harvard astronomers has been principally on photographic plates recording the brightness changes of Rho Cass as far back as JD 2409850 (November, 1885). The records are fairly continuous for the past 45 years. There seems to be no doubt of the existence of several distinct maxima and minima in the light curve of this star. No periodicity is evident in the variations, which are executed in an interval of the order of a hundred days.

A few spectra had been classified by the late Miss Annie Cannon; these and all other spectra available have been independently classified by Mrs. Mayall and Mrs. Cecilia Payne-Gaposchkin. Their results show the spectrum of earliest recorded type as supergiant *F*8p (1885), the latest as *M*5p (1946), in good agreement with the work at Yerkes. During the intervening time the spectrum has varied between *F*8 and *K*5, generally of the latest type when the star was faintest. However, at least once it was *K*5 when the star was near maximum.

Little can be said of what actually causes the peculiar behavior of this star. Those interested in keeping abreast of the very latest in astronomical knowledge will do well to watch for further reports by astronomers who are trying to solve the riddle of Rho Cass.

MAN-MADE METEORITES

The September issue of *Science Illustrated* reports that possibly as early as October 20th one of the V-2 rockets being fired at the U. S. Army Ordnance Proving Ground may carry a man-made meteorite. Dr. Fritz Zwicky, of California Institute of Technology and astronomer at Mount Palomar, has designed the meteorite and the system which will launch it from the nose of the rocket when a height over 100 miles is reached. It is not definite whether the meteorite will become a satellite of the earth, fly off into space, or fall back to the ground to be consumed by the atmosphere. It will weigh less than a pound and astronomical telescopes will be used to follow its path in space.

The INDEX for Volume V

is now in preparation. Its style is similar to previous indexes, including title page; author, title, subject, and topic references. Send 35 cents in stamps or coin, or include it with your subscription renewal check or money order. Your copy of the index will be mailed as soon as it is printed.

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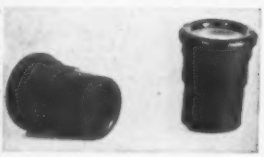

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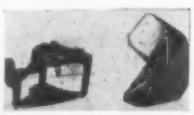

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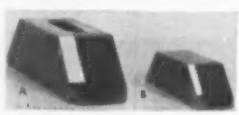

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THE IDEA of something new in the way of a finder intrigued me for some time. What is a finder, anyway, if not just another low-powered telescope? A beginner like myself would need a finder for the finder! I might mistake one star for another on account of the magnification of the distances of the stars from each other. So I discarded the idea of an ordinary optical finder and began to speculate. A gunsight or a disk with a central opening is difficult to use on a very dark night.

When walking through the neon shop in my place of business, I caught sight of those a's and o's bent out of glass tubes. I remembered a vial of luminous (phosphorescent) powder someone had given me some time ago, and my problem was solved. Next day I asked the "pretzelbender" at our office, as we call him, to make me a ring out of a glass tube. It took him just three minutes. That evening at home I filled it with the luminous powder, and, taking a small diaphragm, I went outdoors, held the two objects arm's length apart — and it worked.

There are many ways in which this type of finder can be made, and the materials can no doubt be varied. The main idea is to have it luminous. If my glass ring were to break, I might use a wire one, painted luminous, or some kind of plastic. The notes which follow and the accompanying diagrams describe some of the details of the finder's construction, as made for my 6-inch reflector. (See the front-cover illustration.)

The supports for the ring and eye disk are hardwood blocks 62 x 23 x 17 millimeters, square to all faces, and shaped as shown in Figs. 1 and 2. Before rounding the wide side edges of the top of the ring block, mark off two centers for 7.5 holes — the distance depends on the spread of the glass tube ends. The remaining wall can be chopped out, and a clearance of about two millimeters around the tube should be filled with cotton to take up shock. Razor cuts are shown in the drawings where the flanges on the shims are to fit the blocks. The eye disk block is cut with a hacksaw, and a paper shim glued to one side of the cut takes up the slack when the eye disk flange is inserted.

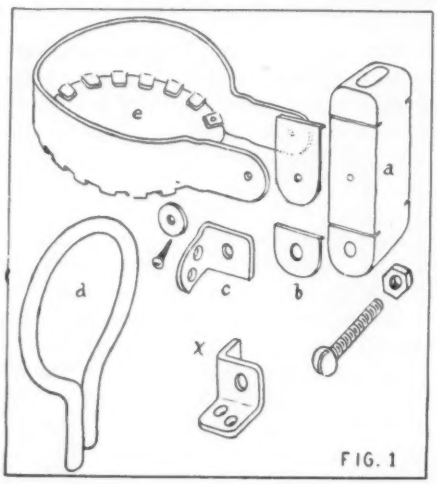

FIG. 1

Both blocks swivel on bolts, and pressure of nut and bolthead against the brass flange and block, with anchored copper shims in between, gives any desired friction to maintain the upright position or out-of-the-way position of the ring and eye disk.

The flanges (c) are of brass and extend lower than the bottom of the rounded block to reach the curvature of the tube, producing a small gap between the tube and the block. Flange **x** in Figs. 1 and 2

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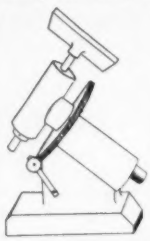

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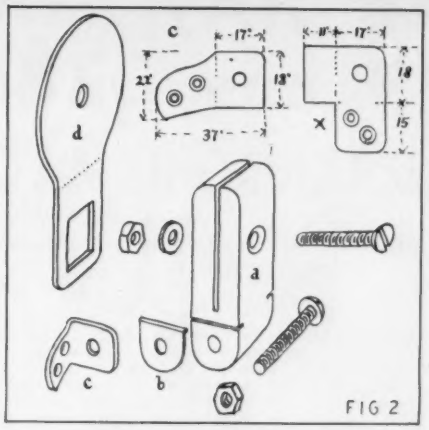
is a substitute where tube rings do not offer adequate height. To get correct center for shims and brass flanges, shave a lead pencil for the length of the bolt hole to a smooth fit, and tap all marks so that the drill does not slip. Make holes in shims larger than the bolt holes so they will not bind and are interchangeable. The flanges have to be numbered after marking and punching; in that way any inequality in the entrance and exit of the bolt hole in the block is neutralized.

Before marking off wood-screw holes for the eye disk block, two points have to be established in line with the axis of the tube. Screw the front block on temporarily, just with the two outside screws. Make a pencil mark on the tube where the left copper shim is located. Clamp a pencil to a right triangle — the pencil



should not touch the tube, but should point toward the optical axis of the main telescope. Turn the mark previously made until it is right under the pencil, and check the tube for level with the table on which it is setting. Pick up the triangle and set it down where the rear sight is located and push it gently to touch the tube, marking this point with another pencil. This is the location of the right copper shim (**b**) of Fig. 2.

The ring has a cover, **e** in Fig. 1, which protects it when folded into the out-of-the-way position. The cover is of aluminum, which takes great patience to work and solder, but looks neater than other materials. The diagram shows roughly how it is designed. Fitting the cover also takes a little patience. Take another block of wood of the same width and thickness as the shaped blocks — its length is im-

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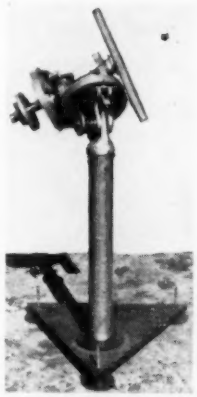

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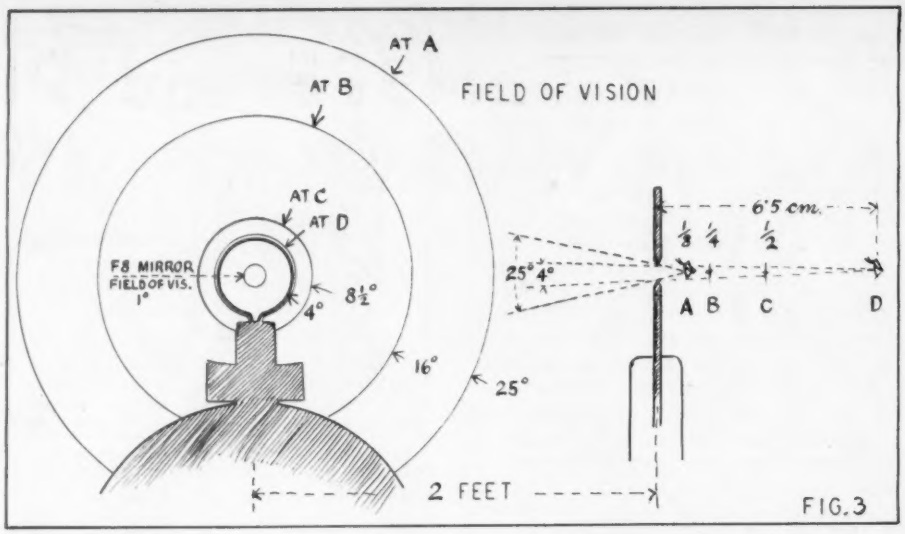

FIG. 3

material. Clamp it between the flanges. Put sandpaper on the tube and work strokes in line, with the tube, cover, and block all in the same line to bring the cover to a fit on the tube.

Fig. 3 depicts the approximate field of view of 25° seen through the eye disk at **A**. Position **B** corresponds to 16°, taking in the constellation of Orion. At **D**, 6½ centimeters behind the eye disk, the luminous ring is just visible for final centering of the object you expect to find in your telescope eyepiece.

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12 mm Dia.	80 mm F.L.	ea.	$ .50
23 mm Dia.	162 mm F.L. coated,	ea.	1.00
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25 mm Dia.	126 mm F.L. coated,	ea.	1.35
26 mm Dia.	104 mm F.L. coated,	ea.	1.25
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LEMAN PRISM 2⅞" long .....ea. 3.00
PENTA PRISM 26 m/m x 28 m/m Face, ea. 3.00
115° AMICI PRISM 10 m/m Face .....ea. 1.25
RIGHT ANGLE PRISM 23 m/m Face ..ea. 1.25
RIGHT ANGLE PRISM 47 m/m Face ..ea. 2.50
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CROSSLINE RETICLE 29 m/m Dia. ....ea. .50
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Binocular Set of Lenses and Prisms ..... **$25.00 Postpaid**

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All Items Finely Ground and Polished but Some Edges Slightly Chipped or Other Slight Imperfections Which We Guarantee Will Not Interfere with Their Use. Come Neatly Packed and Marked.

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Set No. 1-Y — "Our Advertising Special" — 15 lenses for $1.60 Postpaid, plus 10-page idea booklet. For copying, ULTRA CLOSE-UP SHOTS macro-photography, experimental optics, magnifying and for making a two power f/16 Telephoto Lens, "Dummy Camera," Kodachrome Viewer, DETACHABLE REFLEX VIEW-FINDER for 35 mm. cameras, stereoscopic viewer, ground glass and enlarging focusing aids, TELESCOPES, low power Microscopes and for many other uses.

NEW 50-PAGE IDEA BOOK "FUN WITH CHIPPED EDGE LENSES"
Contains wide variety of projects and fully covers the fascinating uses of all Lenses in sets listed above . . . only **$1.00 Postpaid.**

RETICLE SET—5 assorted, engraved reticles from U. S. Gunsights. **Stock No. 2035-Y..$1.00 Postpaid**

35 MM. KODACHROME PROJECTING LENS SET—Consists of Achromatic Lens for projecting, plus a Condensing Lens and piece of Heat Absorbing Glass with directions.
Stock No. 4025-Y ..... $1.95 Postpaid

35 MM. KODACHROME PROJECTING LENS SET—Consists of 2 Achromatic Lenses for projecting, plus 2 Condensing Lenses and piece of Heat Absorbing Glass with directions.
Stock No. 4029-Y ..... $3.10 Postpaid

RIGHT ANGLE PRISM—Flint Optical Glass, size 41 mm. by 91 mm. by 64 mm. Use in front of camera Lens to take pictures to right or left while pointing camera straight ahead. Also used in front of camera Lens to reverse image in direct positive work. Two of these Prisms will make an erecting system for a Telescope.
Stock No. 3076-Y .....$3.00 Postpaid

SPECTROSCOPE SETS

These sets contain all Lenses and Prisms you need to make a Spectroscope plus FREE 15-page Instruction Booklet

Stock No. 1500-Y—Hand Type Spectroscope, **$3.45 Postpaid**

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ALL THE LENSES YOU NEED TO MAKE YOUR OWN TELESCOPE!

ALL ARE ACHROMATIC LENSES

GALILEAN TYPE — Simplest to Make but has Narrow Field of View.

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PRISM TELESCOPES—Use Prism instead of Lenses to Erect Image. Have wide field of view.

Stock No. 5012-Y—20 Power Telescope, **$7.25 Postpaid**

ACHROMATIC LENSES

Stock No.	Dia. in mms.	F.L. in mms.	Price
6158-Y*	18	80	$1.00
6162-Y	25	122	1.25
6164-Y*	26	104	.80
6168-Y	29	76	1.25
6171-Y	32	171	1.00
6173-Y*	34	65	1.00
6176-Y*	38	131	1.00
6177-Y*	39	63	1.10
6178-Y*	45	189	1.50
6179-Y*	46	78	1.25
6182-Y	27	51	1.25
6183-Y	44	189	2.50

*ASTERISKED ITEMS are uncemented, but FREE cement and Directions included with uncemented sets.

USES:—Use these Lenses for making Projecting Lenses, Low Power Microscope Objectives, corrected Magnifiers, substitute enlarging Lenses, Eye-Piece Lenses, Macro-photography, Gadgets, Optical Instruments, etc., etc.

MOUNTED PROJECTION LENS

A mounted f 2.1; 3.5 inch F.L. Projection Lens mfgd. on a Navy contract to be used on a 35 mm. Projector. Low reflection coated. Perfect condition. Black finish threaded at rear end. Outside diam. approx. 2 inches.
Stock #4031-Y ..... $12.00 Postpaid

POLARIZING FILTER—Diam. 73 mm. Perfect condition.
Stock #637-Y ..... $3.00 Postpaid

GIANT SIZE RED AND AMBER FILTERS

Filter material is cemented between glass. All ¾" thick.

Stock No.	Color	Diam.	Price
706-Y	Red	7-7/8"	$2.00
707-Y	Red	5-7/8"	1.50
708-Y	Amber	7-7/8"	1.50
709-Y	Amber	5-7/8"	1.00

USES: For large camera filters, for large size spotlights, for darkroom lights (spectroscopically tested), for interior decorating, for display tray in home or store.

RAW OPTICAL GLASS

An exceptional opportunity to secure a large variety of Optical Pieces both Crown and Flint glass (seconds) in varying stages of processing. Many prism blanks.
Stock No. 703-Y—8 lbs. (min. wt.)—**$5.00 Postpaid**
Stock No. 702-Y—1½ lbs. .....**$1.00 Postpaid**

POLARIZING RING SIGHT (Something New in Optics) — Utilizes the interference pattern created by a basal section of calcite or sodium nitrate crystal between crossed polarizers. Diam. 32 mms. — Thickness 7 mms.
Stock #2067-Y ..... $2.00 Postpaid

MISCELLANEOUS ITEMS

Stock No.	Item	Price
3006-Y	Porro Abbe Prism	$0.25 each
2024-Y	10 Pieces Circular A-1 Plate Glass (Diam. 31 mm—for making Filter)	.25
3021-Y	Amici Roof Prism (3rd Grade)	.25 each
523-Y	Six Threaded Metal Reticle Cells	.25
624-Y	Neutral Ray Filter size 4¾" x 2½"	.25
3022-Y	Round Wedge 65 mm. diam. ..	5.00 each
16-Y	Level Vial, 48 mm. long	.20 each
1040-Y	6 Power Magnifier—diam. 25 mm.	.25 each
2036-Y	Standard Crossline Reticle — diam. 29 mm.	.50 each
1034-Y	Burning Glass Lens	.25 each
535-Y	Small First Surface Mirror ..	.30
3003-Y	Amici Roof Prism with Corrected Roof	2.50
633-Y	2 Combination Polarizing and Infra-Red Filters, diam. 20 mm.	.50

(Minimum Order on Above—$1.00)

WE HAVE LITERALLY MILLIONS OF WAR SURPLUS LENSES AND PRISMS FOR SALE AT BARGAIN PRICES. WRITE FOR CATALOG "Y"— SENT FREE!

PRISMS

Stock No.	Type	Base Width	Base Length	Price
3040-Y	Right Angle	33 mms.	23 mms.	$1.25
3053-Y	Right Angle	70 mms.	168 mms.	3.00
3001-Y	Lens Surface	20 mms.	14 mms.	2.00
3006-Y	Porro-Abbe	9 mms.	9 mms.	.25
3009-Y	Porro	52 mms.	25 mms.	1.00
3029-Y	Dove	16 mms.	65 mms.	1.25
3036-Y	80 Degree Roof	60 mms.	36 mms.	4.00
3038-Y	Roof Prism	18 mms.	34 mms.	2.50

TANK PRISMS

PLAIN OR SILVERED

90-45-45 deg. 5¾" long, 2⅛" wide, finely ground and polished.

Stock #3004-Y Silvered Prism (Perfect) .. **$2.00 Postpaid**

Stock #3005-Y Plain Prism (Perfect) .. **$2.00 Postpaid**

Stock #3100-Y Silvered Prism (Second) ... **$1.00 Postpaid**

Stock #3101-Y Plain Prism (Second) ... **$1.00 Postpaid**

(Illustrated Book on Prisms included FREE)

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DEEP-SKY WONDERS

THESE DESCRIPTIONS represent a sweeping with a 6-inch rich-field telescope of objects plotted by Norton in upper Cygnus.

M39, $21^h\ 30^m.5$, $+48°\ 13'$; bright loose cluster lacking in fainter stars. Better seen with 50-mm. binoculars. 527, $21^h\ 26^m$, $+47°\ 05'$; small but bright cluster that fades into the dust of the Milky Way.

NGC 7039 and 7027 could not be located with the 6-inch f/4 reflector.

597, about $20^h\ 03^m$, $+44°$, a fine cluster of faint stars that would look better in a larger instrument.

537, about $22^h\ 03^m$, $+46°\ 20'$; just over the border in Lacerta is a fine cluster of fainter stars with a "train" that sweeps eastward to 2 Lacertae. On the north edge a dark lane seems to cut the edge off the group and sweeps eastward. All through the region dark lanes are clearly visible with 20x.

WALTER SCOTT HOUSTON

Chart correction: Beta and Gamma Lyrae should be reversed.

STARS FOR OCTOBER

from latitudes 30° to 50° north, at 9 p.m. and 8 p.m., local time, on the 7th and 23rd of the month, respectively. The 40° north horizon is a solid circle; the others are circles, too, but dashed in part. When facing north, hold "North" at the bottom, and similarly for other directions. This is a stereographic projection, in which the flattened appearance of the sky itself is closely reproduced, without distortion.

EVENING STARS FOR SOUTHERN OBSERVERS

THIS CHART is prepared for a basic latitude of 30° south, but it may be used conveniently by observers 20 degrees on either side of that parallel. These southern charts appear in alternate months, but always two or three months in advance, to allow time for transmission to observers in any part of the world. The sky is here shown as it appears on Dec. 7th at 11 p.m., Dec. 23rd at 10 p.m., Jan. 7th and 23rd at 9 p.m. and 8 p.m., respectively. Times for other days vary similarly, four minutes earlier per day. These are local mean times which must be corrected for standard time differences. The 30° horizon is a solid circle; the other horizons are circles, too, those for 20° and 40° south being dashed in part. When facing south, hold "South" at the bottom, and similarly for other directions. Observers in the tropics may find north circumpolar stars on any of our northern star charts. For other charts in this series, see issues of alternate months, December, 1944, to June, 1945, and September, 1945, to the present.